Railway Engineering and Maintenance

One of America's Famous Trains

THE NEW SOUTHLAND

CENTRAL OF GEORGIA RAILWAY

FROM Chicago to Tampa, Florida—1,327.3 miles—THE NEW SOUTHLAND averages 43.4 miles per hour on a schedule of 30 hours and 50 minutes. Over its own rails it averages 44 miles per hour—fastest schedule between Chicago, Cincinnati and the west coast of Florida. THE NEW SOUTHLAND operates through eight states—Illinois, Indiana, Michigan, Ohio, Kentucky, Tennessee, Georgia, and Florida and along the west coast of the peninsula state to St. Petersburg and Tampa. This famous flyer travels almost a *million miles* a year—968,929 miles of transportation using the most modern equipment—completely air-conditioned throughout. Smooth riding qualities of main line track can be most efficiently and economically protected by HY-CROME *Spring Washers*—good for millions of miles of the hardest service, year after year.

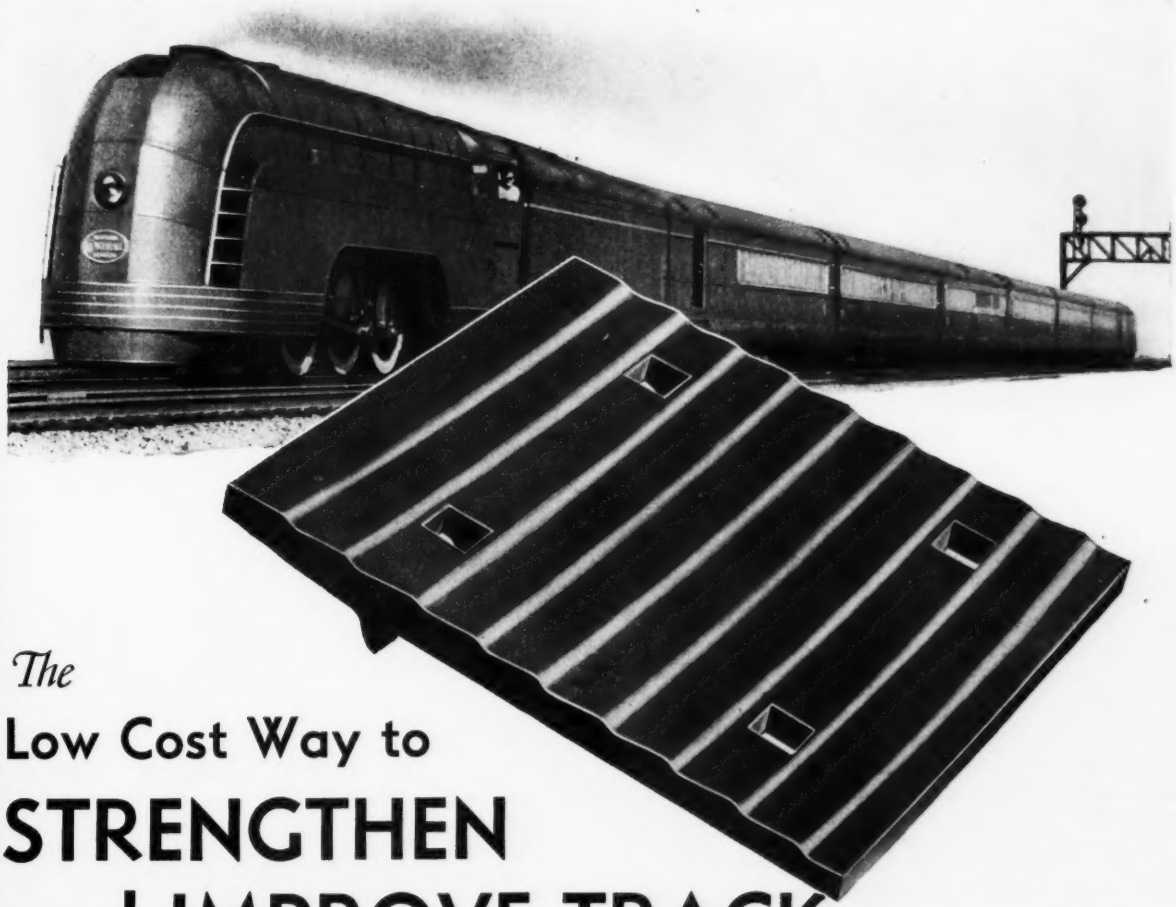
Reliance HY-CROME *Spring Washers*

REActive Deflected Meets A. R. E. A. Spec.	THACKERAY *For screw spike use*	HY-REACTION *For track bolts*	STANDARD *For general use*	HEAVY DUTY *For frogs—crossings*	DOUBLE *For special use*	BONDI *Used as*

EATON MANUFACTURING CO. RELIANCE SPRING WASHER DIVISION, MASSILLON, O

Sales Offices: New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal

MODERNIZED TRACK



The

Low Cost Way to STRENGTHEN and IMPROVE TRACK

LUNDIE Tie Plates meet present-day high speed requirements by producing a stronger and safer track structure. Lundie Plates distribute the load with minimum mechanical wear and hold track to gauge without cutting the ties. They provide correct inclination so wheels track properly, and help to maintain a refinement of surface very essential for smoother and easier riding at high speeds. Lundie Plates not only answer these requirements of modernized track—but minimize tie renewals and make possible a general all-round reduction in maintenance expenses.

THE LUNDIE ENGINEERING CORPORATION

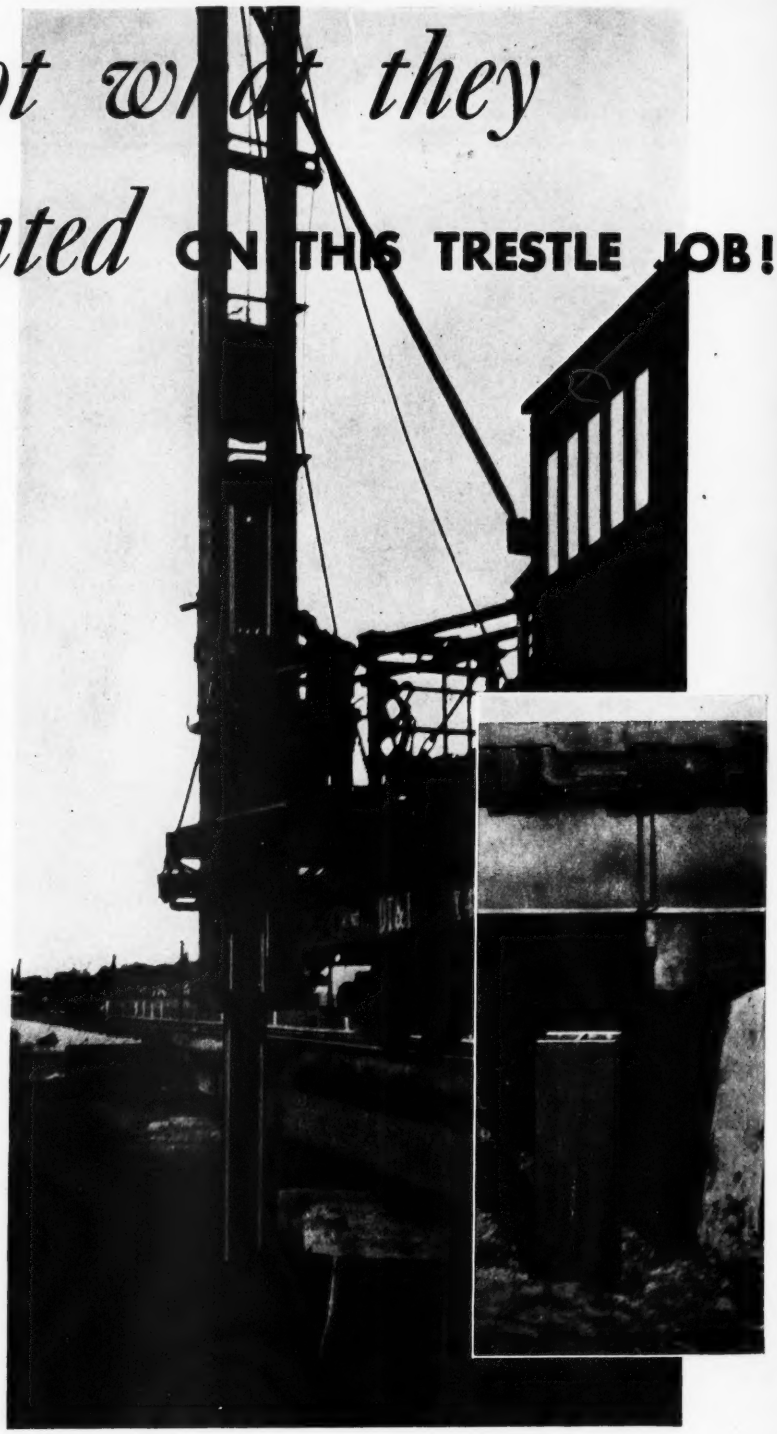
Tie Plates—Rail Clips—Ardco Rail and Flange Lubricator

19 West 50th St., New York 59 E. Van Buren St., Chicago

LUNDIE TIE PLATE

Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, and Canada, $2.00; Foreign $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

They got what they Wanted ON THIS TRESTLE JOB!



THE SITE: An old trestle near Hamler, Ohio belonging to the Detroit, Toledo & Ironton Railroad.

THE PROBLEM: To replace this old trestle at lowest cost, least disturbance to existing structure, and with no interruption to traffic.

THE SOLUTION: 14″ USS Steel Bearing Piles 28′ long were selected for the job. They were driven with a 2800 lb. drop hammer through 5′ of ordinary clay into 14′ of hardpan. No special equipment was necessary. All driving was done by the regular railroad maintenance crew. Today the bridge is reconstructed as a 19′ span, open deck type trestle, using steel stringers on a heavy concrete cap for E-70 loading. There are three steel piles to a bent thus giving about a 60 to 65 ton load per pile. The engineer makes this one significant point: At each bent it was only necessary to remove one tie to drive the steel piles. Thus, even though a complete job of underpinning was necessary, there were no other alterations or disturbances to the existing structure.

THE CONCLUSION: If your foundation problems demand that heavy loads be carried on individual piles—if the piles must resist lateral forces causing high bending stresses—if the trestle or bridge must be replaced without interruption to traffic, specify USS Steel Bearing Piles. They insure lasting and economical construction. Booklet, containing photographs of recent installations, free on request.

U·S·S STEEL BEARING PILES

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh *Chicago*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

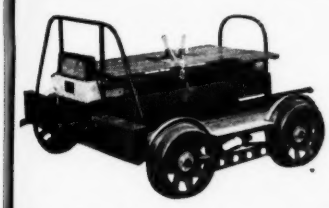
ERFORMANCE ON THE JOB COUNTS

M9 SERIES B ALUMINUM

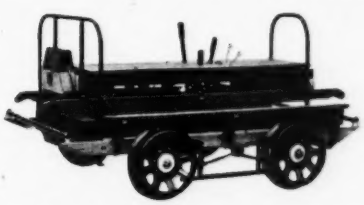
E-MAN INSPECTION CAR . . . LIFT 85 POUNDS

"A Revolutionary Advance" . . . was the verdict of railroad men when they first inspected this Fairmont M9. Yet, Fairmont in no sense aims at the revolutionary . . . its specialized engineering and practical knowledge of maintenance seeks rather the building of improvement upon correct fundamental design. But the M9 *did* bring a revolutionary advance . . . it brought, for the first time, the major safety factor of center loading, a full sized, center-load car with a lift of only 85 pounds; it led the way in new light weight construction with the use of Haskelite, Aluminum Alloy and other modern metals; with the exclusive feature of extension handles operating either front or rear for greater ease in handling . . . and it now has the famous Fairmont Model O engine for a margin of surplus power unequaled by any other car in the field. Years of performance has tested this car—has proved that, under the worst of weather conditions, it has the power and stamina to go through wherever wheels may contact rails for traction. Fairmont Railway Motors, Inc., Fairmont, Minn.

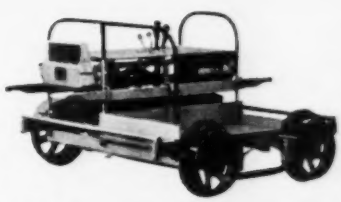
Inspection Motor Cars . . . Section Motor Cars . . . B & B and Extra Gang Cars . . . Gas-Electric Ditchers . . . Shapers . . . Ballast Cleaners . . . Ballast Drainage Cars . . . Mowers . . . Weed Burners . . . Extinguisher Cars . . . Power Cars: Air, Electric, Paint Spray, Tie Tamping . . . Rail Coaches . . . Motor Car Engines . . . Push Cars and Trailers . . . Roller Axle Bearings . . . Wheels and Axles.



Series D—One-to-Four-Man Inspection Car—ALUMINUM. Lift 96 Pounds.



● M14 Series D—Light Section Car—ALUMINUM. Lift 96 Pounds.



● 59 Series C—One-Man Inspection Car. Lift 101 Pounds.

ALL THE RAILWAY MOTOR CARS IN SERVICE TODAY

Fairmont

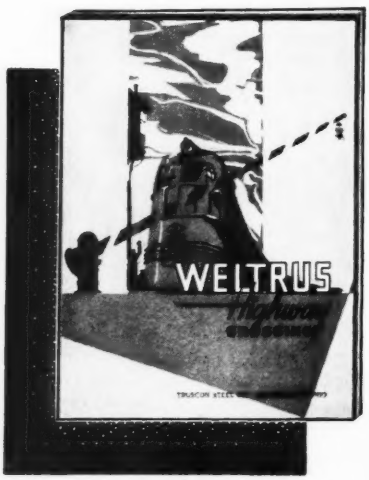
More than Half are Fairmonts

Another Aid to "SAFETY FIRST-" *friendliness too!

TRUSCON WELTRUS HIGHWAY CROSSINGS

SEND FOR THIS INFORMATION

Truscon has just completed a new, brief, but fully descriptive catalog explaining and illustrating TRUSCON WELTRUS HIGHWAY CROSSINGS. Exclusive features of Weltrus Highway Crossings, Weltrus Intertracks Slabs and Weltrus Header Sections are illustrated in this catalog. ... A copy awaits your request.



Railroad executives are thinking . . . planning . . . acting toward greater safety, greater comfort . . . greater SERVICE than ever before. • No details contributing to public good will escape consideration of railroad "progress planners." For example, the subject of safer, smoother, more durable highway crossings is receiving more attention than ever. • Truscon Weltrus Highway Crossings are replacing rough, dangerous, worn-out crossings as another aid to "SAFETY FIRST—*friendliness too!*" Furthermore, many railroads are discovering that their maintenance costs of highway crossings have tapered to zero wherever Truscon Weltrus Crossings have been installed. Railroad "progress planners" are invited to investigate.

**Famous slogan of the Association of American Railroads*

TRUSCON STEEL COMPANY YOUNGSTOWN, OHIO

Practical economy dictates the modernization of tamping methods

LOW FIRST COST
LOW COST OPERATION
NO BLOCKING OF TRACKS
ONE MAN PORTABILITY

Equally efficient for large or small gangs and for tamping, cribbing or breaking ice.

A REALLY PORTABLE TOOL FOR BREAKING UP ICE AROUND TERMINALS IN WINTER TIME

BARCO

BARCO MANUFACTURING COMPANY
1805 W. Winnemac Avenue, Chicago, Illinois

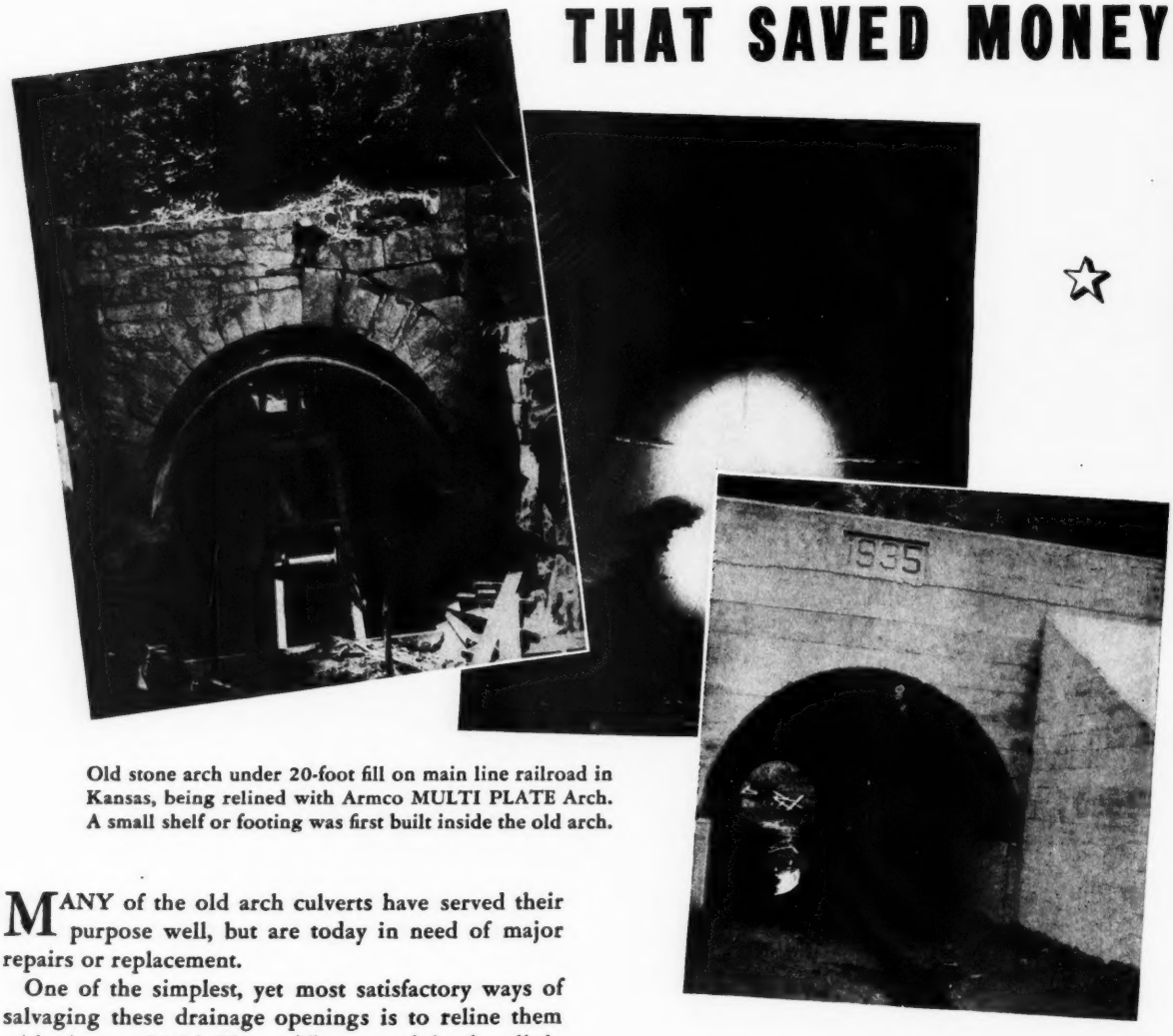
The Holden Co., Ltd.
In Canada

Montreal — Moncton — Toronto — Winnipeg — Vancouver

UNIT TYTAMPERS

Another Relining Job

THAT SAVED MONEY



Old stone arch under 20-foot fill on main line railroad in Kansas, being relined with Armco MULTI PLATE Arch. A small shelf or footing was first built inside the old arch.

MANY of the old arch culverts have served their purpose well, but are today in need of major repairs or replacement.

One of the simplest, yet most satisfactory ways of salvaging these drainage openings is to reline them with Armco Multi Plate. There need be but little reduction in waterway area.

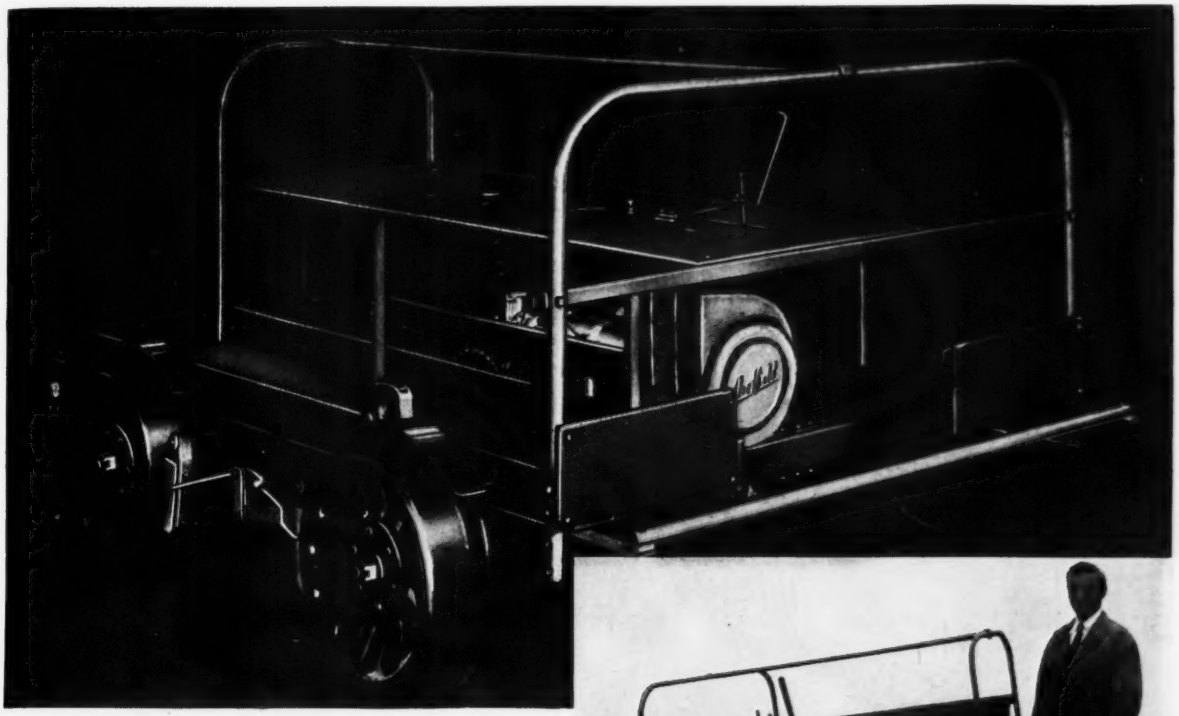
These thick corrugated plates are quickly bolted together to form a strong, durable structure, either as an arch or a pipe.

Let an Armco drainage engineer discuss the application of Multi Plate to your particular problems. Just call or address the nearest office listed at right.

INGOT IRON RAILWAY PRODUCTS CO.
(Member of the Armco Culvert Mfrs. Assn.)
Middletown, Ohio • Berkeley, Calif.

Philadelphia • St. Louis • Salt Lake City • Los Angeles
Minneapolis • Houston • Portland • Atlanta • Denver
Chicago • Dallas • El Paso • Spokane • Cleveland
Pueblo • Sidney • Richmond

ARMCO MULTI PLATE MULTI ARMCO PLATE **For Economical Drainage**



Light enough for one . . . strong enough for eight

Light weight is not sacrificed to capacity in the Sheffield "49". By careful design, the use of heat-treated aluminum and other alloys, lifting weight is kept down to 164 pounds. And yet it will carry eight men and their tools. Fully loaded with six men, front windshield, and a trailer, the "49" will pull 2000 pounds at 25 miles an hour. Without the trailer, and fully loaded, it will make 32 miles an hour.

For your copy of a new bulletin explaining many improved features of the new Sheffield "49", address Department N731, Fairbanks, Morse & Co., 900 S. Wabash Avenue, Chicago, Illinois.

6795RA21.103

106 YEARS OF PRECISION MANUFACTURING

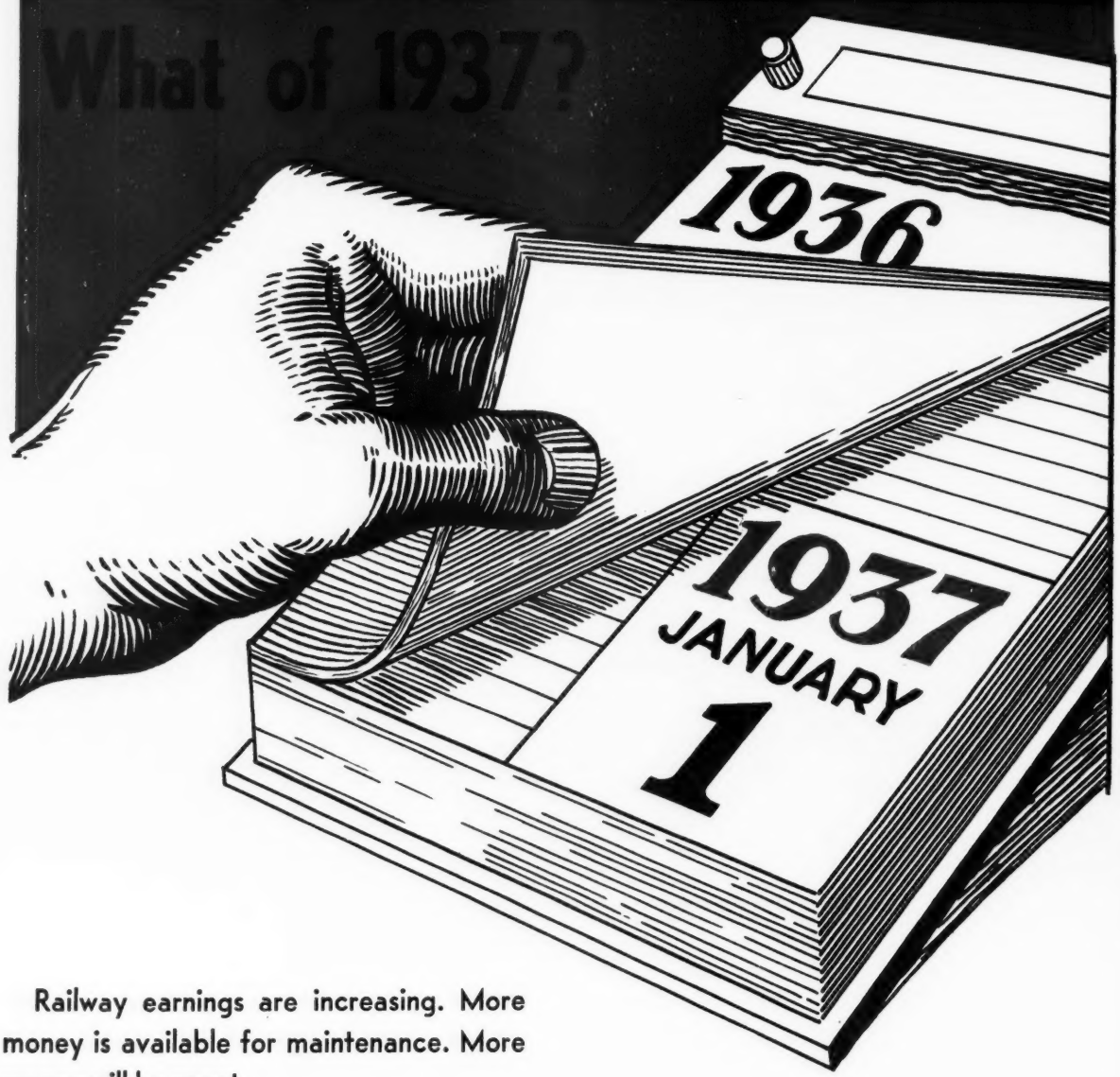
FAIRBANKS-MORSE

Railway Equipment

POWER, PUMPING AND WEIGHING EQUIPMENT

TO RAILWAY SUPPLY MANUFACTURERS:

What of 1937?



Railway earnings are increasing. More money is available for maintenance. More money will be spent.

Rail orders of recent weeks demonstrate that materially larger programs are in the making.

Yet the needs are so great that, even with the most optimistic outlook, local and system maintenance officers alike are confronted with the problem of selection.

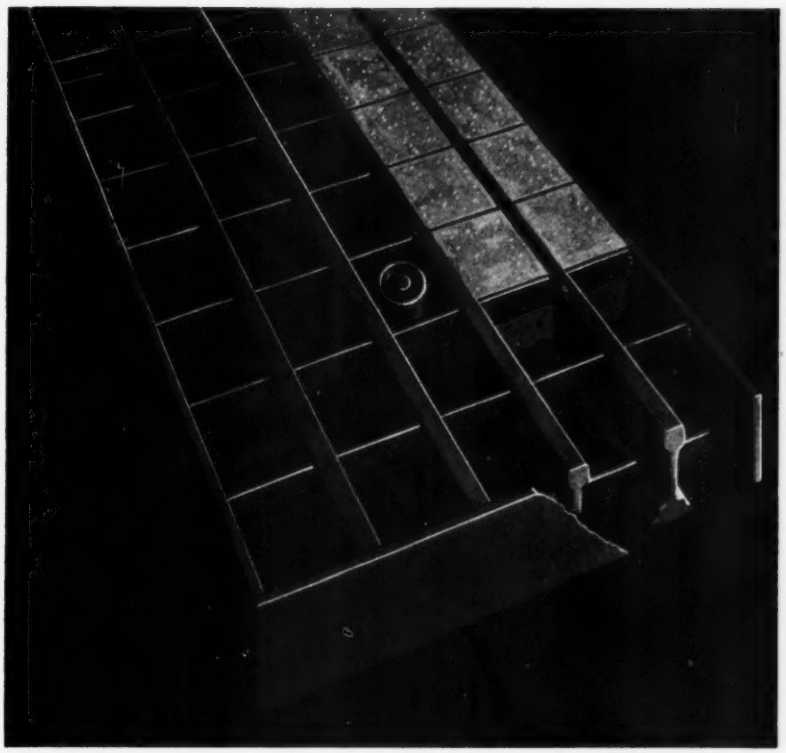
Are you insuring that your products will be on their lists?

Are you keeping the story of your products and of the economies they will effect before these men month after month through the magazine that they read first of all?

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

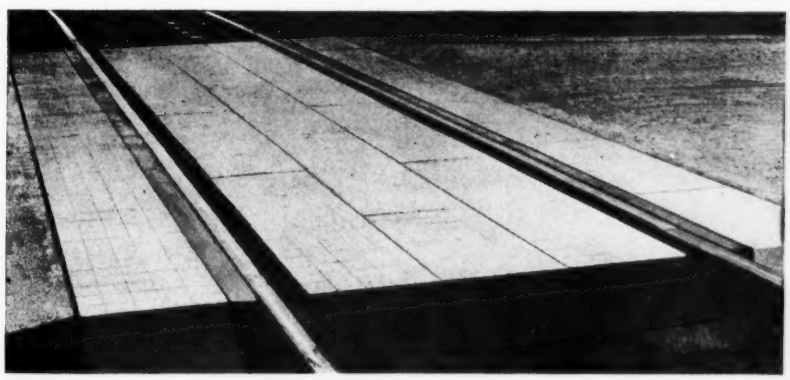
Structurally Correct

TO MAKE CROSSINGS SAFER, LONGER LASTING



(*Above*) A distinctive feature of these units is their unique floating anchorage. The units normally rest on fillers spiked to the ties. The floating anchorage permits a depressing of the ties and track during passage of trains while the crossing units remain in alignment with roadway. Blue print and detailed data on request.

(*Below*) This grade crossing illustrates an I-BEAM-LOK type of construction subject to very heavy traffic, maximum truck loads of 19 tons, for two years. Has required absolutely no maintenance to date.



FOR safety's sake supplement adequate warning signals with adequate crossings. I-BEAM-LOK is a definite improvement in grade crossing construction. Smooth, but anti-skid. Armored against wear. Sturdy. Long lasting. Quickly constructed. Low in maintenance cost.

Examine it. I-BEAM-LOK consists of sturdy I-Beams locked together with intersecting top and bottom cross-bars. All material is Copper-Steel. The heavy steel flat forming ends and sides of each unit is securely welded to the I-Beams and cross-bars. These welds, at 4" centers, insure maintenance of true, square edges on the units and prevent formation of unsightly cracks and chipped, broken out corners and edges.

I-BEAM-LOK, ready for concreting at or near the site of the crossing, is available in standard units 3 feet or 6 feet long. Adaptable for any width of crossing from 12 feet up, in multiples of 3 feet. In case it is necessary to repair track or replace rails, I-BEAM-LOK units can be quickly removed, repairs made and units replaced without loss of any materials. Heavy enough to insure stability and correct alignment in crossing. Light enough to permit removal and replacement with hand labor.

CARNEGIE-ILLINOIS STEEL CORPORATION - PITTSBURGH *and* CHICAGO

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

The Anti-Skid Grade Crossing

I·BEAM·LOK

Armored

UNITED STATES STEEL

No. 96 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: YOUR OWN COPY

November 26, 1936

Dear Reader:

This letter is addressed to those of you who, as supervisory officers, share your copies of Railway Engineering and Maintenance with others of corresponding rank. It is suggested by a letter which I received within the last two weeks, from which I quote the following sentence:

> "As you know, our railway subscribes for Railway Engineering and Maintenance for our maintenance officers and copies are available in our office, but it is always difficult to obtain them for early reading because they are seized by the first one noting their appearance."

I am quoting from this letter because it directs attention to a practice that I have run into on several roads lately.

We are delighted that so many persons are interested in Railway Engineering and Maintenance. We recognize the necessity for economy that has prompted some of the railways to ask officers in the same or adjoining offices to share copies received through subscription by the railway. We appreciate also the spirit that prompts individual subscribers to share the magazine with their associates. Yet I wonder if by so doing, either reader gains the full benefit possible therefrom.

Railway Engineering and Maintenance is edited for practical men. It is a "brass tacks" publication, bringing to you the experiences and practices of other men in the solution of problems comparable with yours. Many of you spend a large part of your time on the line. You can frequently do your best reading there. Also, with the current issue in your pocket, you can frequently discuss an article with your foremen to advantage, using it to crystallize an idea that you have long been attempting to get over. In other words, you can use your magazine to best advantage only if you are free to read it whenever and wherever you have the opportunity and to use it without regard to the desires or rights of some one else. This can be done only if you have your own copy.

And the cost is negligible—less than that of a package of cigarettes a month.

Yours sincerely,

Elmer T. Howson

ETH*JC Editor

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

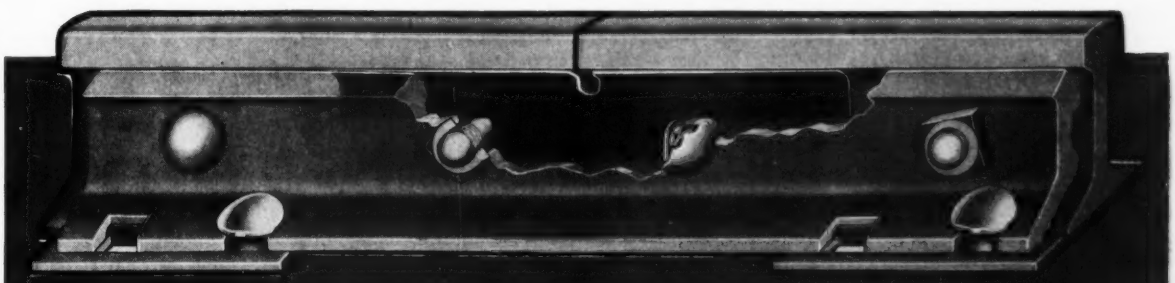
Photo, Courtesy Chicago & North Western Railway

SETTING NEW STANDARDS

• The genius of America's railway officials has set new standards in transportation. Modern high speed traffic, however, imposes stringent requirements on track conditions.

Many leading roads are meeting this situation by the use of True Temper Tapered Rail Joint Shims. This device provides a new standard of economy and efficiency in the maintenance of rail joints. Among others, it accomplishes the following results:

1. Avoids the necessity of duplication of bars.
2. Installation of shims can be carried on without interruption to traffic.
3. Provides the most economical and practical method of restoring worn rail joints.



THE AMERICAN FORK & HOE COMPANY

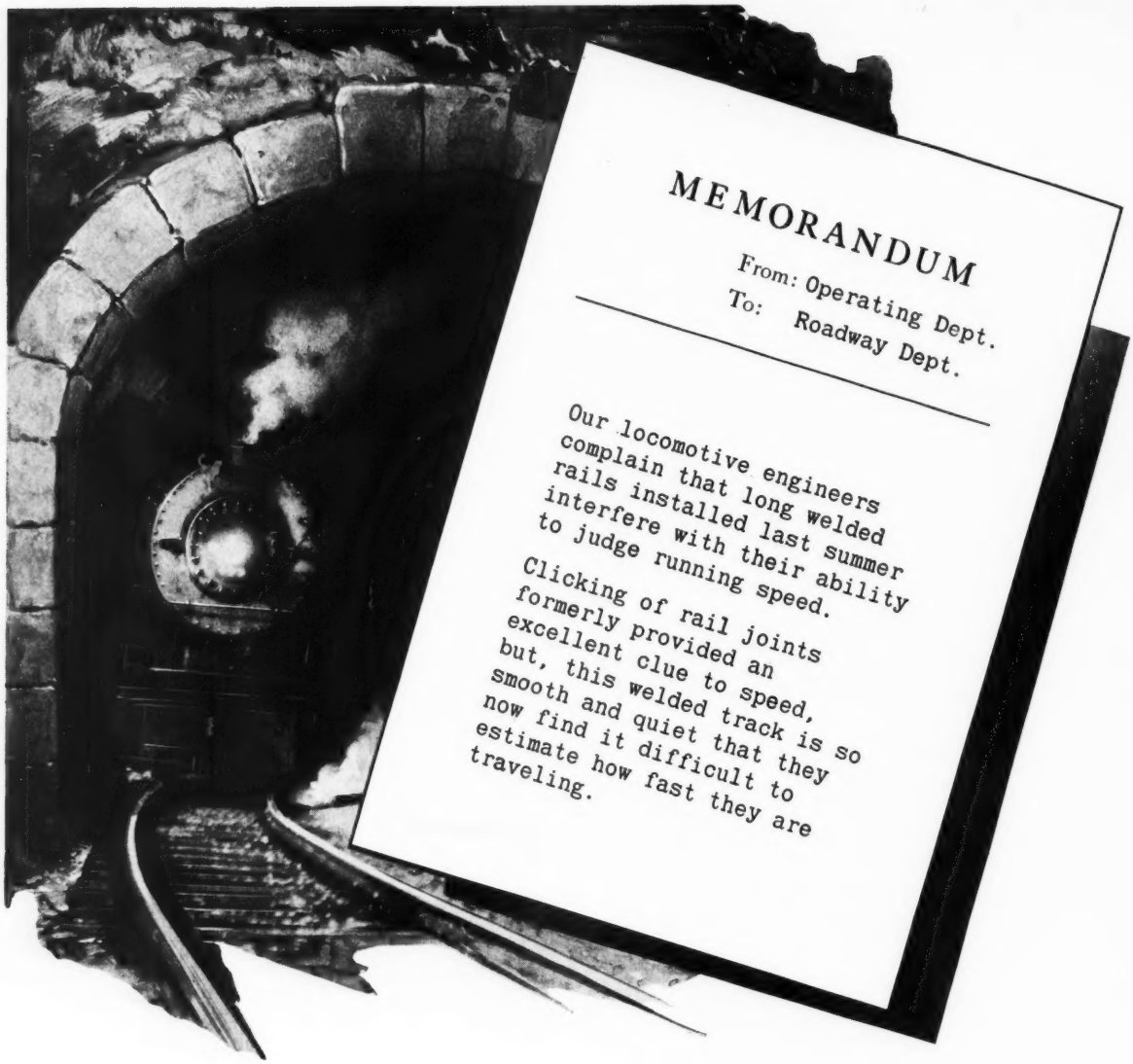
RAILWAY APPLIANCES DIVISION

GENERAL OFFICES
Cleveland, Ohio

DISTRICT OFFICES
Daily News Building, Chicago, Ill.
[illegible] Chambers St., New York, N. Y.

FACTORY — [illegible]

FOREIGN REPRESENTATIVES
Wonham, Inc.
[illegible] Whitehall St., New York, N. Y.
68-72 Windsor House, Victoria Street, London, S. W. 1


MEMORANDUM
From: Operating Dept.
To: Roadway Dept.
Our locomotive engineers complain that long welded rails installed last summer interfere with their ability to judge running speed.
Clicking of rail joints formerly provided an excellent clue to speed, but, this welded track is so smooth and quiet that they now find it difficult to estimate how fast they are traveling.

EVERYONE is pleased with the Thermit welded, continuous rails installed in two tunnels on the Northern Pacific last summer. The only complaint has been a facetious one from the locomotive engineers. In passing through one of the tunnels, it is necessary to pick up speed for a grade at the other end. Formerly, the tempo of the clicking rail joints gave an excellent clue to running speed. With the rail joints eliminated, however, the engineers have had to find other means of judging their rate of travel.

Quiet operation is the outward indication of the underlying reason why long welded rails provide such remarkable economies. With no rail joints for wheels to pound, joint maintenance is banished. Frequent track lining and surfacing become unnecessary. Rail life, it is estimated, is increased 25% to 40%. Wear and tear on rolling stock and motive power are reduced.

Thermit Rail Welds can be installed by your own track forces at little higher cost than ordinary rail joints. But, the first cost is the last cost. It will pay you to investigate. Write for the complete story.

THERMIT Rail WELDING

METAL & THERMIT CORPORATION, 120 BROADWAY, NEW YORK, N. Y.
ALBANY • CHICAGO • PITTSBURGH • SO. SAN FRANCISCO • TORONTO

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

Published on the first day of each month by the

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 West Adams Street, Chicago

NEW YORK
30 Church Street

CLEVELAND
Terminal Tower

WASHINGTON, D. C.
1081 National Press Bldg.

Samuel O. Dunn, *Chairman of the Board;* Henry Lee, *President;* Lucius B. Sherman, *Vice-President;* Cecil R. Mills, *Vice-President;* Roy V. Wright, *Vice-President* and *Secretary;* Frederick H. Thompson, *Vice-President;* Elmer T. Howson, *Vice-President;* F. C. Koch, *Vice-President;* John T. DeMott, *Treasurer.*

Subscription price in the United States and Possessions, and Canada, 1 year $2, 2 years $3; foreign countries, 1 year $3; 2 years $5. Single copies, 35 cents each. Address H. E. McCandless, Circulation Manager, 30 Church Street, New York, N.Y.

Member of the Associated Business Papers (A.B.P.) and of the Audit Bureau of Circulations (A.B.C.).

December, 1936

Editorials - 773

Railroading—Still Unsolved—Safety—Track Abuse—More Money—Planning

Meeting Winter's Challenge - - - - - - - - - - - - - - 776

How the Illinois Central prepares for snow storms in its Chicago terminal and an account of the appliances used

Termites in Railway Structures - - - - - - - - - - - - - 782

A description of this enemy of wood, its habits, methods of detection and measures for its control and elimination, by Harry R. Duncan

High-Speed Track—How Good Must It Be? - - - - - - - 786

An account of the Pennsylvania's investigation of the behavior of tracks under high speed electric locomotives

Making Steel Piles from Scrap Rails - - - - - - - - - - 790

Rock Island develops design of bearing piles that proved economical in locations where hard driving was encountered

Union Pacific Bridge Maintenance Methods - - - - - - - 791

Railroad reorganizes work to provide for complete programming of each gang's assignment and to permit of complete preframing

What's the Answer? - - - - - - - - - - - - - - - - - 795

New Devices - 802

News of the Month - - - - - - - - - - - - - - - - - - 803

ELMER T. HOWSON
Editor

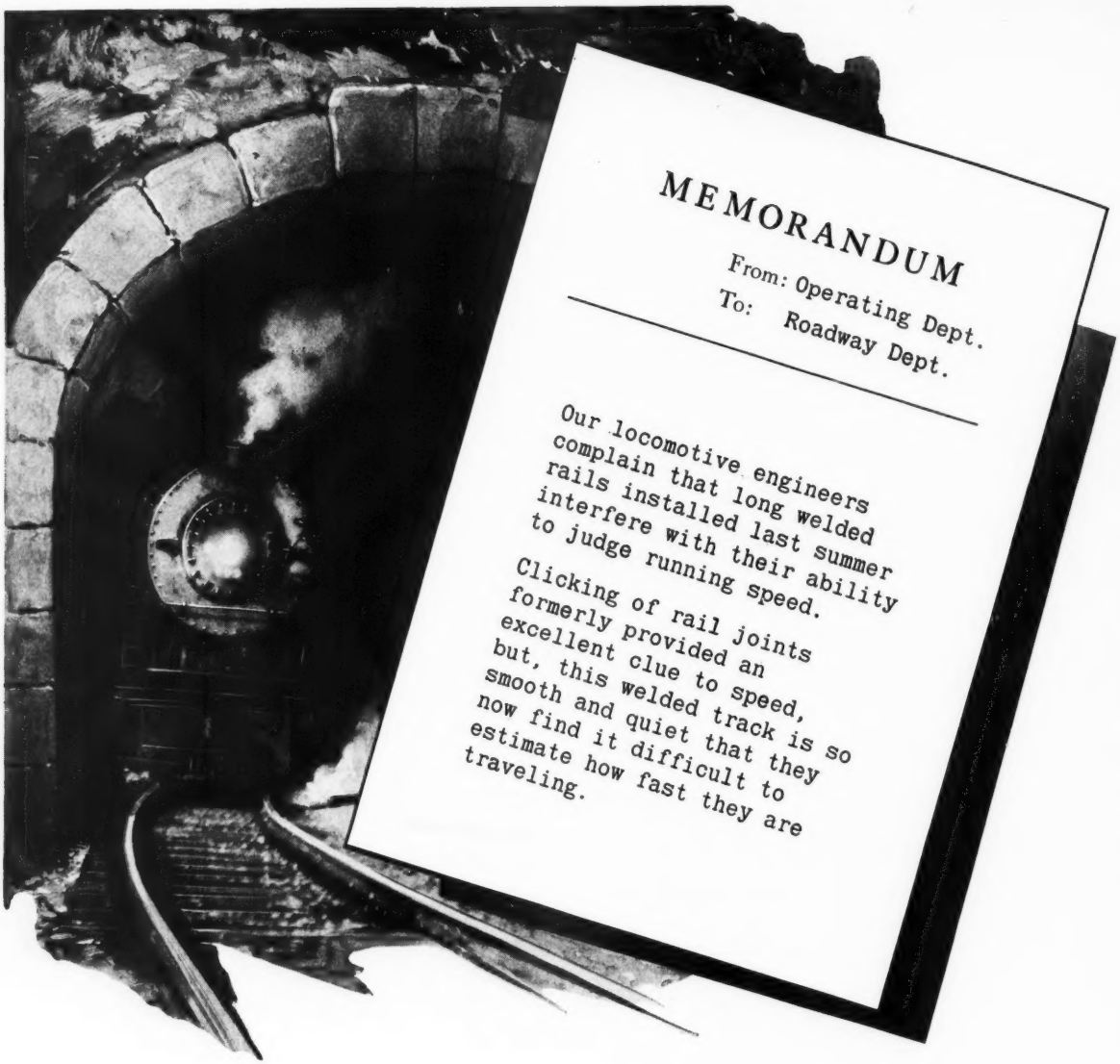
WALTER S. LACHER
Managing Editor

NEAL D. HOWARD
Eastern Editor

GEORGE E. BOYD
Associate Editor

M. H. DICK
Associate Editor

F. C. KOCH
Business Manager


MEMORANDUM
From: Operating Dept.
To: Roadway Dept.
Our locomotive engineers complain that long welded rails installed last summer interfere with their ability to judge running speed.
Clicking of rail joints formerly provided an excellent clue to speed, but, this welded track is so smooth and quiet that they now find it difficult to estimate how fast they are traveling.

EVERYONE is pleased with the Thermit welded, continuous rails installed in two tunnels on the Northern Pacific last summer. The only complaint has been a facetious one from the locomotive engineers. In passing through one of the tunnels, it is necessary to pick up speed for a grade at the other end. Formerly, the tempo of the clicking rail joints gave an excellent clue to running speed. With the rail joints eliminated, however, the engineers have had to find other means of judging their rate of travel.

Quiet operation is the outward indication of the underlying reason why long welded rails provide such remarkable economies. With no rail joints for wheels to pound, joint maintenance is banished. Frequent track lining and surfacing become unnecessary. Rail life, it is estimated, is increased 25% to 40%. Wear and tear on rolling stock and motive power are reduced.

Thermit Rail Welds can be installed by your own track forces at little higher cost than ordinary rail joints. But, the first cost is the last cost. It will pay you to investigate. Write for the complete story.

THERMIT Rail WELDING

METAL & THERMIT CORPORATION, 120 BROADWAY, NEW YORK, N. Y.
ALBANY • CHICAGO • PITTSBURGH • SO. SAN FRANCISCO • TORONTO

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

December, 1936

Editorials - **773**

Railroading—Still Unsolved—Safety—Track Abuse—More Money—Planning

Meeting Winter's Challenge - - - - - - - - - - - - - - - - **776**

How the Illinois Central prepares for snow storms in its Chicago terminal and an account of the appliances used

Termites in Railway Structures - - - - - - - - - - - - - - **782**

A description of this enemy of wood, its habits, methods of detection and measures for its control and elimination, by Harry R. Duncan

High-Speed Track—How Good Must It Be? - - - - - - - - - **786**

An account of the Pennsylvania's investigation of the behavior of tracks under high speed electric locomotives

Making Steel Piles from Scrap Rails - - - - - - - - - - - - **790**

Rock Island develops design of bearing piles that proved economical in locations where hard driving was encountered

Union Pacific Bridge Maintenance Methods - - - - - - - - - **791**

Railroad reorganizes work to provide for complete programming of each gang's assignment and to permit of complete preframing

What's the Answer? - **795**

New Devices - **802**

News of the Month - **803**

Published on the first day of each month by the

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 West Adams Street, Chicago

NEW YORK
30 Church Street

CLEVELAND
Terminal Tower

WASHINGTON, D. C.
1081 National Press Bldg.

Samuel O. Dunn, *Chairman of the Board;* Henry Lee, *President;* Lucius B. Sherman, *Vice-President;* Cecil R. Mills, *Vice-President;* Roy V. Wright, *Vice-President* and *Secretary;* Frederick H. Thompson, *Vice-President;* Elmer T. Howson, *Vice-President;* F. C. Koch, *Vice-President;* John T. DeMott, *Treasurer.*

Subscription price in the United States and Possessions, and Canada, 1 year $2, 2 years $3; foreign countries, 1 year $3; 2 years $5. Single copies, 35 cents each. Address H. E. McCandless, Circulation Manager, 30 Church Street, New York, N.Y.

Member of the Associated Business Papers (A.B.P.) and of the Audit Bureau of Circulations (A.B.C.).

ELMER T. HOWSON
Editor

WALTER S. LACHER
Managing Editor

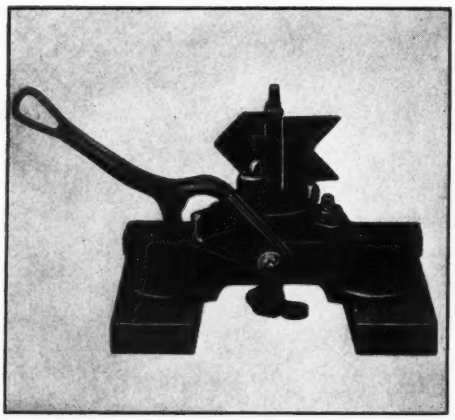
NEAL D. HOWARD
Eastern Editor

GEORGE E. BOYD
Associate Editor

M. H. DICK
Associate Editor

F. C. KOCH
Business Manager

RAMAPO AUTOMATIC SWITCH STANDS

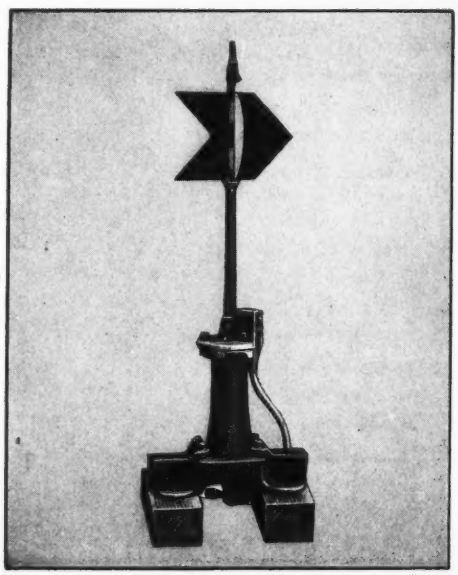


20-B

• The average life of an automatic stand is more than double that of a rigid stand.

The No. 20-B with its newly designed lever provided with an apron to protect its working parts from the entrance of dust and snow is safer and surer in operation. This protection adds still more to the life of the stand.

Automatic stands are replaced only when worn out. They are not broken or damaged by runaway cars.



17-B

• As in other Ramapo Automatic Safety Switch stands, the 17-B provides positive hand throw, a resilient connection to switch points so that no parts can be overstressed and fail through fatigue, and the well tried automatic mechanism which provides protection against broken switch points, damaged stands and derailed cars.

The improved design with less moving parts prevents accumulation of lost motion and insures proper alignment of target and lamp for years.

RACOR

RAMAPO AJAX CORPORATION

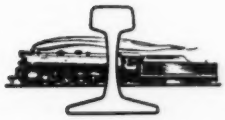
CANADIAN RAMAPO IRON WORKS, LIMITED

General Offices: 230 Park Avenue, N. Y.

Racor Works: Hillburn, New York • Niagara Falls, N. Y. • Chicago, Ill.

East St. Louis, Ill. • Superior, Wis. • Pueblo, Colo. • Los Angeles, Cal. • Seattle, Wash. • Niagara Falls, Ont.

Railway Engineering and Maintenance



Railroading

A Career of Distinction

MORE than half of the 1,100,000 employees of the railways today have been in service 15 years or longer. Approximately 35 per cent have 20 or more years service to their credit. Upwards of one-fourth of them have been employed by the railways for more than 25 years. A very considerable number have service records reaching up to 40 and 50 years. Less than 20 per cent have been in service less than five years. These are highly significant figures for in no other industry of comparable size can one find so large a proportion of men who are devoting their lives to the one form of employment and to one employer.

The "Boomer" Has Gone

In the earlier days when the railways followed closely after, if they did not actually precede, the first settlers into new areas, not a few of those pioneer employees who built and operated these railways were attracted from one job to another by the love of adventure. Service records meant little to these men for if they left one job, they knew that they could secure another on a neighboring road. Even in those days, however, the "boomer" never comprised a large proportion of the employees; today he is almost non-existent.

Yet there is still romance in railroading that has a widespread appeal. Every normal boy is thrilled by trains—at some period in his youth he aspires to be a locomotive engineman. It is in this spirit that railway employees are created. To them railroading is a career —a life work.

Railroad employment is exacting work. To attain a position of responsibility, one must serve an apprenticeship of years. The training is rigorous. Among other characteristics, it develops dependability, a trait that is valuable in any industry but absolutely essential in railroading. Railway work has long attracted men who enjoy sticking to a job through thick and thin; it has little appeal to those who come and go; for the rewards come only to those who qualify through years of training.

Railway service calls for red-blooded men who love a battle—men who accept a washout or a blizzard as a challenge. Railway history is replete with the stories of men who fought against the greatest odds to keep lines open and trains moving, when all nature seemed to conspire against them. No finer record was ever written than that of the thousands of maintenance of way men who, last winter, fought the cold and the blizzards day after day and who gave way to others only when, exhausted and with faces and hands frost bitten, they could continue no longer. Theirs was the task of rescuing trains that were snowbound, of opening lines for the transportation of coal and food to stormbound communities, of maintaining arteries of transportation for the nation's commerce. They met the emergency and won.

Attracts Men of Action

Railway service attracts men of action also because a railway organization moves with military precision, each individual trained in his specific duty and each group directed by an officer who has himself risen from the ranks and knows both the objective and the best way to attain it. Those who have neither the ability nor the willingness to undergo such training fall out early—it is only the determined who survive the testing period to which railroad men are subjected.

It is from such a background that the railway organization of today has come—a background of experience and training, of dependability and loyalty. It is from such a background that a corps of men has been created who recognize the necessity for teamwork and who take pride in their accomplishments. It is not surprising, therefore, that the appellation "railroad man" has come to characterize dependability and versatility in meeting conditions as they arise suddenly and without warning. It is such men who give strength and stability to any industry and any community.

The Men Behind the Train

In these days when the public, and employees as well, are giving so much attention to the new streamlined trains, to the faster schedules, to the air-conditioned coaches and to the many other improvements that are characterizing this new era in railway transportation, one should not lose sight of this large group of employees who provide and maintain the tracks and structures over which these new trains run at such speeds, or of those employees who man and control these trains, or of those many other employees who contribute to the efficiency, comfort and economy with which the public and its property are transported from place to place. It is these men who, after all, make this service possible. They are the life blood of transportation.

When pointing to the achievements of the railways, employees can well afford to emphasize the outstanding and unique position which railway employees, of all departments and ranks hold in our life of today. Theirs is indeed a career. Their records attest to this fact.

Still Unsolved

Power Machines for Trestle Repairs

THE pile driver is older than railroading, the steam-operated hoist goes back to the beginning of metal bridges, concrete mixers have been in use more than a generation, the pile line on a driver is commonly employed for the handling of stringers and caps in trestle construction and renewal. But repair work on trestles or even the renewal of complete decks, involving the handling of sticks weighing a half a ton or more is done in the vast majority of cases with substantially the same tools and equipment that were employed 50 years ago.

This statement implies no criticisms of the men responsible for this work. Experimental use has been made of rail cranes or other light power hoists, but time lost in clearing for trains and other difficulties have militated against their widespread adoption. Some progress has been made in the application of power saws and drills, but the increasing adoption of preframing is reducing the need for field cutting so far as treated timber trestles are concerned.

But whatever the reasons given, it does not necessarily follow that the last word has been said on the use of power equipment in this operation. Perhaps the right machine has not yet been devised. On the other hand, it is entirely possible that the answer lies in a change of procedure rather than in the development of machines adapted to current practice. The problem is one that should challenge the ingenuity of bridge men.

Safety

Never Ignore a Careless Act

THERE are few subjects that railway men approach with a wider variation in attitude than that of safety. Of course all who hold responsible positions on the railroads are convinced that practices that promote safety are desirable. But in too many cases this point of view is an academic one that rarely becomes manifest in any positive action. There are those also who look with disfavor on what they deem over-emphasis of accident prevention in the form of what to them is an unwarranted amount of speech making or a needless promulgation of bulletins, as well as unnecessary severity in discipline, especially where the violation of rules on the part of the men results in the imposition of penalties on the supervisor.

An examination of the accident records of the railroads in the various groups develops the fact that a few roads have been consistent repeaters or near repeaters in the top ranks, which should demonstrate that chance has little influence in the result so far as units as large as entire railroads are concerned. More detailed study will show also that most of the prizes in the annual safety contests are taken by roads that have carried on the most persistent compaigns of accident prevention. On these roads the managements are convinced that investigation, education, admonition and discipline, consistently carried out, are absolutely essential to the practice of safety at all times by all employees.

The most common complaint of the supervisory officer is that his duties compel him to give attention daily to such a multitude of problems that he does not have time to carry on a safety campaign in addition to his other work, but as was said recently by one safety officer—ten minutes a day will accomplish a great deal. How should he use these ten minutes? One method is never to allow an unsafe practice or a violation of safety rules to go unnoticed. Supervisory officers, and foremen also, are keen observers and if they call emphatic attention to every careless, foolhardy or reckless practice that comes under their observation they will be preaching the gospel of safety in a way that will drive the lesson home.

Track Abuse

How Effected by High-Speed Operation

FOR many years railway men have held the general belief that poorly designed locomotives are responsible for excessive abuse of the track. This belief was voiced anew by several of those attending the Roadmasters' convention in Chicago during September, one speaker, while discussing the effect of high-speed train operation on his road, declaring that it is not the high-speed operation of the modern so-called streamlined trains, properly designed for the high speeds at which they are operated, which is causing maintenance of way men concern, but rather, the operation at high speeds of equipment not designed for those speeds. Another speaker declared that he would rather have 10 Zephyrs operate over his track than one out-of-date heavy freight locomotive, operated at a speed far in excess of that for which it was designed.

Until recently, this belief in the destructive action on the track of poorly designed locomotives was based almost entirely upon observation of the track, and was largely qualitative in character, but now maintenance men can turn to an extensive series of actual locomotive and track tests to substantiate their belief. These tests, which were conducted by the Pennsylvania in connection with the purchase of electric locomotives for operation over its newly electrified line between New York and Washington, D. C., are described in this issue. The results of these tests led to many fundamental changes in the design of the locomotive originally considered for this operation because of the severity of this locomotive on the track, and finally, to the adoption of a completely redesigned locomotive, which caused little more abuse of the track when operated at 100 m.p.h., than it caused at operating speeds of 50 m.p.h.

Maintenance men are not afraid of high-speed train operation, but it is unreasonable, and certainly uneconomical, to expect them to maintain smooth-riding, safe track for high-speed, for just any kind of power to be operated over it. With the co-operation of the operating and mechanical departments in developing power suitably designed for the speeds at which it is to be operated, they can be counted upon to provide economically safe track which will meet fully any demands of speed made upon it.

While the vital importance of properly designed power was the primary fact to be learned from the tests made on the Pennsylvania, a second fact brought out, which is of primary interest to maintenance of way men, is the importance of well-maintained track in preventing undue abuse to the track structure by high-speed train operation.

This second fact was that, almost regardless of the class or type of power employed, track that is not well maintained in surface, cross-level and line is subject to much greater abuse than smooth track, especially at speeds above 45 or 50 m.p.h. The tests showed conclusively that on rough track, the lateral blows sustained by the rail increased quite generally with the speed of operation, this increase being rapid to the point of actually distorting the track in the case of some types of locomotives, while much less rapid with other better-designed types of power. It is this phase of the tests made on the Pennsylvania to which maintenance men should give the greatest attention where high-speed operation is involved.

More Money

Railways Continue to Spend More

ORDERS for rail placed thus far this calendar year, total 1,093,607 tons, compared with 658,206 tons ordered in the calendar year of 1935, 568,710 tons in 1934, and 632,381 tons representing the aggregate tonnage of the orders placed in both 1932 and 1933. However, by combining the rail orders for the last three months of one year with the orders for the first nine months of the following year, it is possible to arrive at a comparison that more nearly represents the rail renewal programs for the individual years, since most of the tonnage ordered in the last three months of the year is for laying in the following year. On this basis, the rails ordered for laying in 1935 totalled 487,827 tons while those ordered for laying in 1936 aggregated 737,102 tons, an increase of more than 50 per cent. Indicating the trend for 1937, the orders placed since October 1 of this year already total 548,767 tons, compared with 192,262 tons during the entire last three months of 1935.

The increase in maintenance of way operations as a whole is shown by the expenditures for maintenance of way and structures for the Class I railways, the total outlay for the first nine months of this year being $343,241,002, compared with $297,432,028, for the same period of 1935, an increase of $45,708,974 or 15.4 per cent. It also represents an increase of 22.8 per cent compared with the like expenditures for 1934, and is 42 per cent greater than the outlay during the first nine months of 1933.

Another measure of the greater activity in maintenance of way work is afforded by the record of employment. Thus, for the first 10 months of this year the average number of employees in the maintenance of way department was 226,968, compared with 208,874 for the same period of 1935, 212,936 for 1934 and 199,659 for 1933. The number in September, 1936, was 249,223, which is the largest force employed since October, 1931.

These figures demonstrate, for the railways as a whole, what the most maintenance men have realized in so far as their own individual roads are concerned, namely, that the upturn in maintenance of way appropriations that started in 1934 has continued steadily. There is, moreover, valid ground for the conclusion that the expenditures in 1937 will be proportionately greater than in 1936.

Planning

Of Benefit Even in Emergencies

IN recent years much stress has been laid on advance planning and orderly programming in maintenance. This has invariably referred to routine maintenance and has included everything from laying rail and ballasting to many of the minor tasks of the section gang. Another form of planning is described on a following page—planning for handling an emergency which may or may not occur. In doing this the thought uppermost in the minds of the maintenance officers is to be ready and able to get their forces into action immediately after the emergency appears.

This outstanding example of advance planning is found on the Chicago terminal of the Illinois Central which is faced with a particularly acute problem of fighting snow, partly because of its exposed location, partly because of its many miles of main and yard tracks, its numerous switches and interlockings, and partly because of its intensive traffic, of which about 80 per cent consists of through passenger and suburban trains.

While the organization for handling the snow problem and the arrangements for getting every man on the job quickly are highly interesting, the most arresting feature of the methods employed in this terminal is the large amount and variety of equipment in use. Because of the wide range of conditions which must be met, practically every type of snow-fighting equipment, from brooms and shovels to the latest designs of snow plows and spreaders, finds its use. However, because of the importance of many of the switches in the routing of traffic, a high degree of reliance has been placed in switch heaters, for which reason this terminal is one of the most completely equipped in this respect in the country.

While a large amount of the equipment employed has been designed specially for use in overcoming snow conditions, it is worthy of note that considerable ingenuity has been exercised in adapting for this use, roadway machines which were designed and are normally used for quite different purposes. The personnel of the maintenance organization on this terminal can probably be duplicated on most other roads. The important point is, however, that being faced with a serious problem, the maintenance officers have sought with determination to solve it by every means at their disposal.

Meeting Winter's Challenge

TO KEEP 759 regularly scheduled trains moving during severe snow storms in a terminal which comprises 253 miles of main tracks, 350 miles of yard tracks, 2,041 turnouts, 4 single and 48 double-slip switches, and 10 interlockings, requires thorough organization, adequate advance preparation and the use of a large amount of snow-fighting equipment. This is the problem that confronts the maintenance forces on the Chicago terminal of the Illinois Central, where, as a further indication of the importance of avoiding blocked tracks and inoperative switches, an average of 110,000 suburban passengers, in addition to the through passengers of three trunk line railways, are handled daily, all of whom must be delivered to destination promptly. Furthermore, during a storm, and continuing until the city streets are cleared, the number of suburban passengers may be increased to 130,000 or even 135,000, requiring additional trains under the most adverse conditions of operation.

Tracks Are Exposed

Aside from the large mileage of tracks, the numerous switches and the great number of trains, averaging one every two minutes for the full 24-hour period, the snow problem on this terminal is intensified by its exposed location. For 6.5 miles South from Roosevelt road, the main line follows the shore line of Lake Michigan, with only a narrow public park between the water and the tracks, which are thus exposed to the full fury of northeast storms, which during the winter are generally accompanied by heavy snowfall. In fact, it is not uncommon for considerable more snow to be deposited on these tracks during a northeast storm than is recorded by the weather bureau instruments which are located further inland.

From Roosevelt road north to Randolph street, more than a mile, the tracks lie between retaining walls about 20 ft. below the surface of Grant park, where under certain conditions of wind and snow, drifting may be very bad. This is a section of most intensive traffic, in addition to which a large amount of switching is done, and here there are many switches, slip switches and crossings.

Beginning a little south of Randolph street, the freight tracks enter the South Water Street yard, which extends north more than one-half mile to the Chicago river and easterly to the lake. In this section are the in the outbound freight houses and extensive team-track facilities, together with other provisions for receiving and delivering freight.

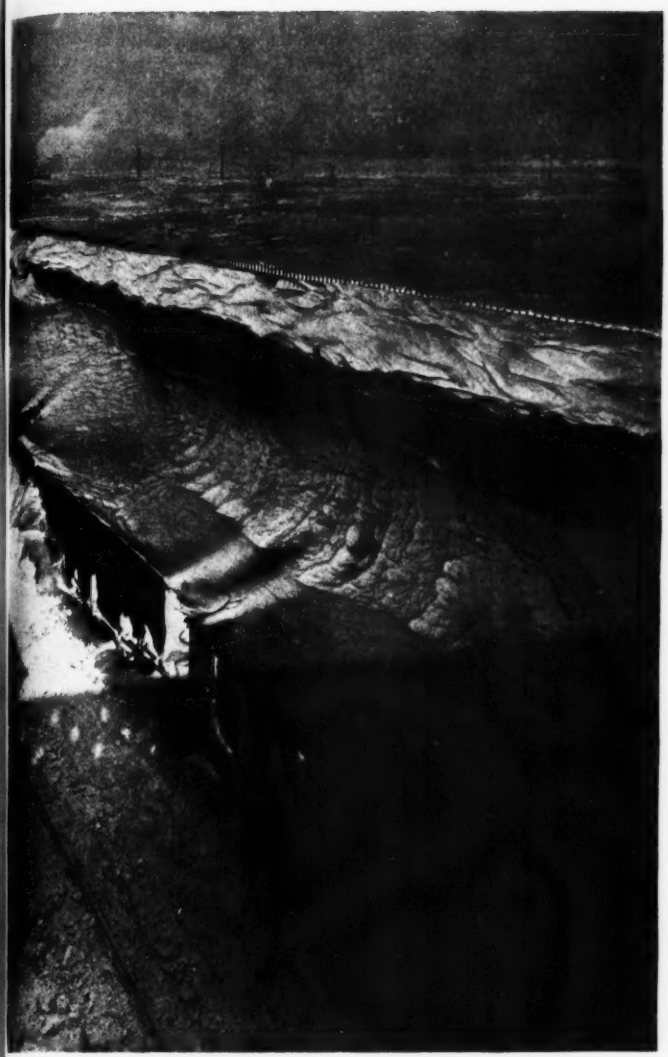
Junctions are located at Sixteenth street, where the Omaha line turns to the west; at Sixty-Seventh street, with the suburban line to South Chicago; and at Kensington, 15 miles from Chicago, with the Blue Island suburban line and with the Michigan Central, which latter road uses the Illinois Central line from this point to Roosevelt road and to the South Water Street yard where it has independent freight facilities. Markham yard, the terminal freight yard and engine terminal for the main line south from Chicago, is at Homewood, 24 miles south of Chicago, while Matteson, four miles farther south, is the terminus for suburban trains. All suburban tracks are electrified, as are all of the freight tracks as far south as Thirty-Ninth street. Ten miles to the west, Hawthorne yard is the freight terminal for the line to Omaha.

An example of Heavy Drifting North of Roosevelt Road on the Illinois Central

Ten interlockings control the movement and routing of traffic. Eight of these interlockings are vital points in the fighting of snow, for if any one of them is allowed to become tied up for any reason, it leads within a short time to the complete demoralization of train schedules. Another critical point lies immediately north of Roosevelt road, where the six suburban tracks cross from the east to the west side of the right of way, and freight tracks from the south and west enter Jackson street yard, the receiving and dispatching point for freight destined to or moving from South Water street.

Because of the extent of the terminal territory and of the numerous points where clear tracks and operative switches are of vital importance, organization, adequate preparation, and intelligent direction of the forces

Keeping 603 Miles of Tracks, 2,093 switches and 10 interlockings open despite blizzards and cold weather, so that 759 regular trains can be kept moving through its Chicago terminal, is the problem facing the maintenance forces on this terminal of the Illinois Central. This article describes the organization which has been developed, and the many varieties of snow-fighting equipment employed to keep these tracks and switches open and to prevent interference with the normal receipt and delivery of freight.



during a storm, are essential to success in coping with the severe snow conditions which can normally be expected every winter. Recognizing this fact, over a period of years a well-knit and smooth-functioning organization has been developed, in which each man knows what is expected of him and carries out his assignment with military precision. In addition to perfecting an organization, a large amount of snow-fighting equipment has been provided. In selecting and assigning this equipment the maintenance officers have given careful consideration to the particular needs of each point where it is to be used and to the conditions surrounding its use.

Because of the large number of switches in the main tracks, more than 400, of which some 250 are in constant use in routing traffic, primary reliance is placed in the use of switch heaters. Chief of these is the Winter King, an oil-burning semi-portable type, of which 4,000 are in use at 237 main-line turnouts, 4 single slips and 41 double slips, as well as a large number of other switches not in yards, which are only slightly less important than those in the main tracks with respect to interruption to the steady flow of traffic. Other switch-heating and snow-melting equipment includes Q & C electric switch heaters which are applied to 68 switches and double slips; 150 Protect-O-Seal snow-melting cans; several Hauck torches; and steam coils which are installed on 19 turnouts, 4 single slips and 1 double slip.

Among the heavier units are one double-end, right-hand and one double-end, left-hand Russell snow plows with flangers; two double-end Jordan wedge plows, with flangers; one Pordan spreader with special snow front; one Jordan spreader with

Right—557 Trains Use These Tracks in 24 Hr.

Left—More than 800 Movements Are Made Over These Crossings Daily

wings; primarily for cleaning yard tracks, but used also on main tracks; five Fairmont weed burners for melting snow on the car retarders and ladders at Markham yard and for cleaning switches at South Water Street yard; and three Caterpillar tractors with bulldozers, one of which is also equipped with an Anthony snow loader. In addition to these special units, 19 locomotives are equipped with steam connections or steam jets for furnishing steam to coils at interlockings or for blowing out switches.

During the summer all of the heavy units are given a thorough inspection and needed repairs are made in plenty of time for them to be sent to their appointed places well in advance of winter. During this period all of the switch-heating and snow-melting devices are checked, and requisitions are made for units to replace those that are worn out or were damaged during the previous winter.

Preparing for September

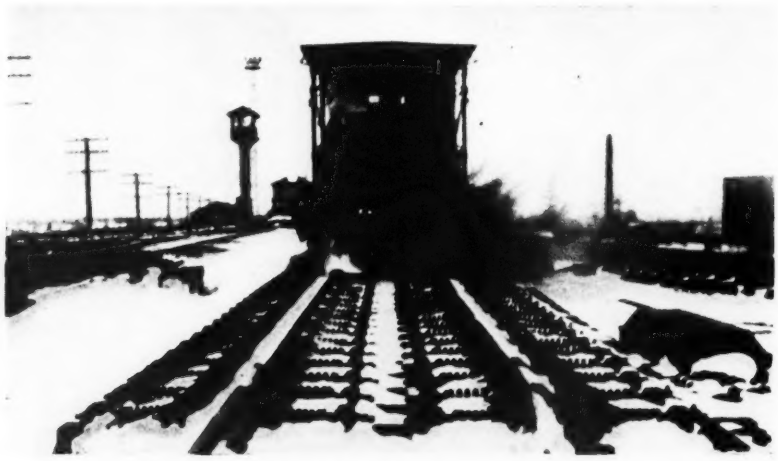
Late in September or preferably early in October, the division engineer calls a meeting of the key men of his staff and representatives of other departments and sub-departments which will assist or be involved in the snow-fighting operations. At this meeting, the operations of the previous winter are reviewed and suggestions are made for changes that may be desirable in methods or assignments. The general and detailed instructions that are issued every year are reviewed and amended if necessary.

All assignments are then made, so that every man will know where to report. When the list is made up, each man is notified of his assignment and is given such special instructions as may be necessary, in addition to the general and detailed instructions which are sent to all of the key men.

So far as practicable, these assignments are repeated from year to year, so that the men will go to points with which they are familiar and will thus be able to draw on their previous experience. These assignments include men from all branches of the operating department, not from the maintenance department only. For this duty, a number of men are also drawn from the engineering force in the general office, to assist at the headquarters office, to act in supervisory capacities on the track and to make up the force of traveling inspectors.

To insure that there will be no misunderstanding and that all efforts will be co-ordinated, the duty of every key man is outlined and this information is shown in the instructions which are issued shortly after the meeting. At the time of this meeting the list of addresses and telephone numbers of those who are to be called, is checked carefully and needed revisions are made.

At the proper time and generally in connection with the regular maintenance program, the routine tasks of preparing for winter are completed. About November 1, however, special preparations are begun. An important item in this preparation is the assembly of special stock of brooms, shovels and other snow tools, which are placed at strategic points where their issuance will be under control. In addition to this distributed stock, an emergency stock is stored in quarters provided for this purpose at Roosevelt road, close to the division engineer's office, which is issued to casual labor as it becomes necessary to add to the regular forces during the progress of a storm.



Melting Snow From a Car Retarder with a Weed Burner

At the same time that the emergency stock of tools and supplies is being assembled, preparation of the switches for the reception of the Winter King heaters is started. This consists of cleaning out the cribs, removing the ballast to about the bottom of the ties to give ample room for the flame to spread under and around the rail. As the cribs are cleaned, sheet metal is applied to the sides of the ties adjacent to the individual heaters as a precaution against scorching the wood if the wind blows the flame against the ties.

As rapidly as this preparation is completed, the Winter Kings, previously filled with oil and equipped with suitable wicks, and with the protecting caps in place, are inserted under the rail and switch points. They require no further attention until it becomes necessary to light them when a storm arrives. Normally, 12 heaters are required for a switch, 6 under each point, although this may be reduced to 8 if the switch is so located that it is protected from the wind. Forty are used on double-slip switches, but this may be increased to 50 if it has movable-point frogs.

When a Storm Breaks

If a storm starts during the day the assigned men are expected to go to their appointed posts without notification. If it breaks during the night, the dispatcher, who is located at Randolph street, notifies the division engineer, the division superintendent, the superintendent of suburban service, the assistant engineer of the division and the supervisory officers north of Kensington. He also notifies the master mechanic, the general electrical foreman, the trainmasters and the terminal agent. At the same time, the night trainmaster at Markham notifies all supervisory officers between Kensington and Matteson. These men, in turn, notify their subordinates and all of the men who are on special assignment.

Set Up Headquarters

The Illinois Central owns an office building across Roosevelt road from its main offices, in which an office has been prepared for use as headquarters during snow storms, with special provisions for communication with all points on the terminal and special arrangements for handling casual labor and keeping the time of all extra men. As soon as it starts snowing, the division engineer and the men who are to comprise his staff during the emergency, move to the headquarters office, where the regular routine of his office will not be disturbed.

Complete reliance is placed in the regular maintenance forces during

the early stages of a storm, and this force forms the nucleus of the whole snow-fighting organization, but if the storm is severe or long continued, these men must be supplemented or relieved for rest. For this reason, arrangements have already been made with a number of labor agencies to obtain casual labor and as soon as it is known that they will be needed the scources from which they can be obtained are notified.

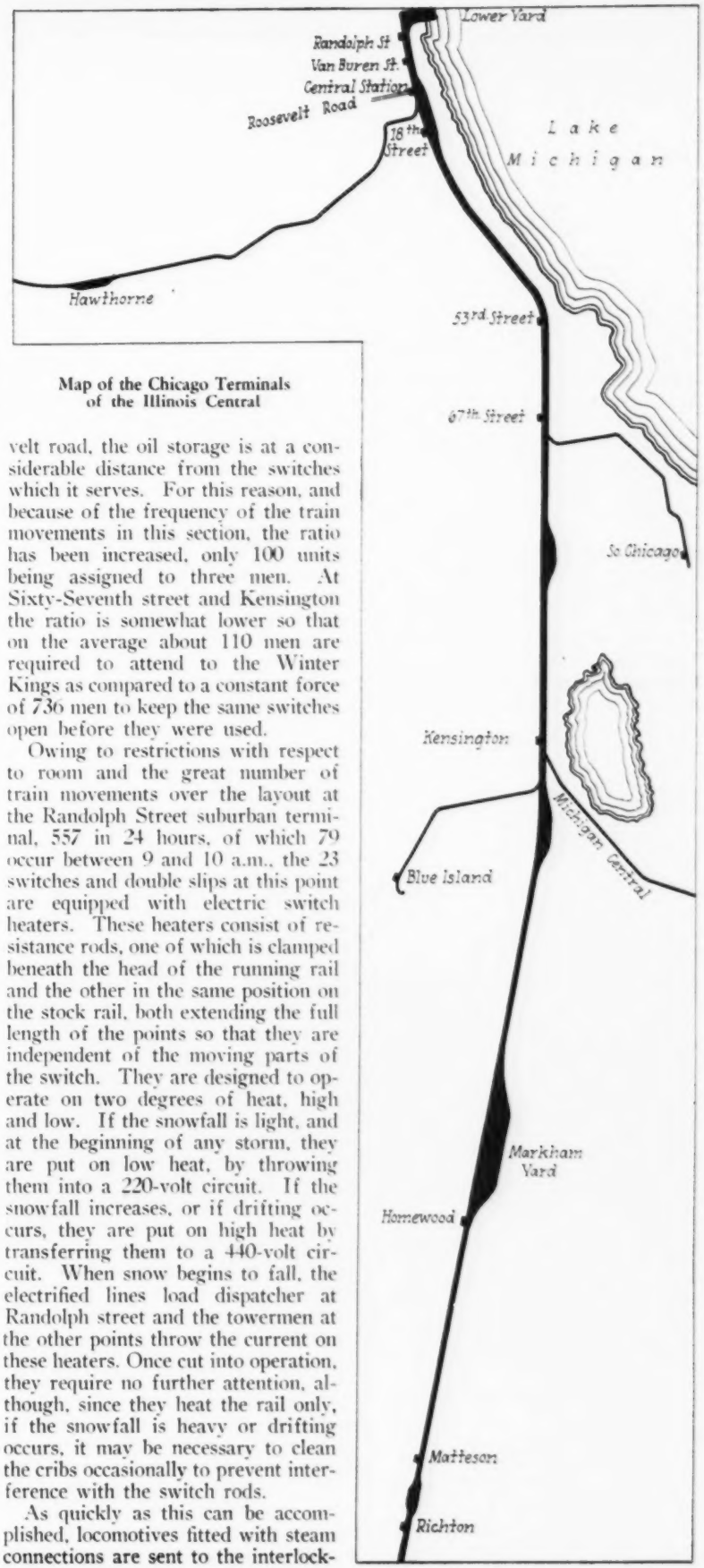
Organizing Casual Labor

Certain competent and experienced trackmen and men from bridge and building gangs are selected to act as foreman of the casual labor gangs, and these men report to the headquarters office to receive the men, to assist in organizing them and to take out the gangs when they are ready. When one of the casual gangs is organized, it is sent to the emergency storehouse where the men are given shovels, brooms, scoops, snow pushers, etc., depending on the service they are to perform. The gang is then sent to its destination on the next suburban train.

If the storm starts during the day, the regular forces begin to light the Winter Kings at once. If at night, they do this as soon as they arrive. In making the distribution of these heaters, 2,800 are assigned to the territory between Van Buren and Eighteenth streets, which includes the through passenger station, the coach yard and the point where the six suburban tracks cross from the east side of the right of way to the west side, crossing a large number of freight and other tracks in doing so.

As has been stated, a total of 4,000 Winter King switch heaters are in use on this terminal, 2,800 of which are in the vicinity of Roosevelt road, and they are kept in place continuously during the winter months, ready for lighting at a moments notice. Of the remaining 1,200, some 700 are used at Sixty-Seventh street and 500 at Kensington. The 150 Protect-O-Seal snow-melting cans are assigned as needed. Experience has shown that these cans provide the surest and quickest means of lighting the Winter Kings and a sufficient number are kept at the three points to insure that the switch heaters will be lighted in the minimum time. At Roosevelt road, 12 men are assigned to do this lighting, while 4 or 5 men can accomplish this at other points.

Winter Kings hold seven points of oil and when filled will burn for eight hours. Ordinarily, therefore, three men can tend to about 200 of the units. However, owing to the number of tracks in the vicinity of Roosevelt road, the oil storage is at a considerable distance from the switches which it serves. For this reason, and because of the frequency of the train movements in this section, the ratio has been increased, only 100 units being assigned to three men. At Sixty-Seventh street and Kensington the ratio is somewhat lower so that on the average about 110 men are required to attend to the Winter Kings as compared to a constant force of 736 men to keep the same switches open before they were used.



Map of the Chicago Terminals of the Illinois Central

Owing to restrictions with respect to room and the great number of train movements over the layout at the Randolph Street suburban terminal, 557 in 24 hours, of which 79 occur between 9 and 10 a.m., the 23 switches and double slips at this point are equipped with electric switch heaters. These heaters consist of resistance rods, one of which is clamped beneath the head of the running rail and the other in the same position on the stock rail, both extending the full length of the points so that they are independent of the moving parts of the switch. They are designed to operate on two degrees of heat, high and low. If the snowfall is light, and at the beginning of any storm, they are put on low heat, by throwing them into a 220-volt circuit. If the snowfall increases, or if drifting occurs, they are put on high heat by transferring them to a 440-volt circuit. When snow begins to fall, the electrified lines load dispatcher at Randolph street and the towermen at the other points throw the current on these heaters. Once cut into operation, they require no further attention, although, since they heat the rail only, if the snowfall is heavy or drifting occurs, it may be necessary to clean the cribs occasionally to prevent interference with the switch rods.

As quickly as this can be accomplished, locomotives fitted with steam connections are sent to the interlock-

ings at Weldon and Sixty-Seventh street for heating the steam coils under the switches. Except for the snow-melting cans which have been mentioned, and the few Hauck snow-melting torches, the switches at the remaining interlockings are cleaned by hand. To insure that these plants will not be tied up in a severe storm, eight other locomotives are equipped with dome connections and steam hose for use in blowing snow from the switches, and these locomotives are sent to the several plants when they are needed. In addition, four locomotives in regular switching service are equipped with steam jets under the pilots for blowing out switches when this becomes necessary. This arrangement is of particular advantage when switching industry and other remote sidings.

Melting Snow With Weed Burners

One of the noteworthy developments in fighting snow, which was first tried out in this terminal, is the use of weed burners for keeping car retarders and switches clear of snow. This use came about through the fact that during a severe storm shortly after the car retarders were placed in service at Markham yard, one of the earliest installations of this device, extreme difficulty was experienced in keeping them in operation during periods of drifting snow. As a last resort, a weed burner which was close at hand was tried out and was so successful in removing snow and ice from the car-retarder mechanism that it was also tested on the hump ladders, where it proved to be equally successful. As a result, this use has been extended until today five of these machines are assigned to snow-melting service on the terminal.

One weed burner is able to keep 200 car-retarder units, 114 switches on the hump leads and 108 car skates clear of snow, and on occasion it is sent to help out at the interlocking at the south end of Markham yard. Two additional weed burners are able to keep the remaining 414 switches in this yard clear of snow. In fact, it is rarely necessary to send additional men to this yard.

South Water Street yard is the delivery point for the bulk of the freight arriving at Chicago, except interchange shipments, and the largest collecting point for outbound shipments. It is of the utmost importance, therefore, that there shall be no interference with the switching of the team tracks and the freight houses, and that transfer trains shall move on regular schedules. Because of its exposed situation on the lake front and its complicated track layout, this yard has always been a critical point during severe storms. For this reason, for several winters, two weed burners have been assigned to supplement the hand cleaning of the switches. Since this practice was first started, this yard has ceased to be the serious problem it was formerly. The machines do not replace so many men here as at Markham, because there are no long ladders and the switches are scattered over a wide area.

Double Slip Equipped with Electric Heater After 14 Hr. of Continuous Snowfall

It is of equal importance that the driveways serving the team tracks and freight houses be kept clear of snow so that the receipt and delivery of freight will not be impeded. For many years this was one of the most difficult problems confronting the maintenance forces, since the total area of these driveways is very great, the snowfall is usually heavy and the snow drifts badly, while because of the intensive development of the property there is no place for local disposition of the snow. As a consequence it has always been necessary to load the snow in cars and ship it out.

At times it has required as many as 200 to 400 men during the day to clear the snow and pile it so that it would cause the least interference with the driveways. Then during the early part of the night, before the team tracks were set, as many as 600 men with scoops would be thrown in to load the snow into cars for disposition elsewhere. As a further measure of the magnitude of the problem of snow disposal on this terminal, as many as 15,000 cars have been loaded with snow during a single winter. Not all of these came from the South Water Street teamways, however, for this total included what was loaded at some of the interlockings, at Weldon coach yard and elsewhere where space is at a premium.

All of this is now changed. Two Caterpillar tractors equipped with snow pushers are used for assembling the snow in piles or windrows for loading. The pusher is then removed from one tractor and replaced with an Anthony snow loader, which can also be used as a bulldozer and which loads the snow into gondolas or wagons. So far, these two machines, each with one operator, have been able to cope successfully with all storms. Likewise, one tractor with a bulldozer is assigned to the coach yard. Here, the method of disposal is somewhat different, for the accumulation of snow must be loaded by hand as no set time is available for this operation.

Miles of Platforms

Another problem of considerable magnitude arises by reason of the large number of suburban and through passenger platforms. Obviously, with 110,000 to 135,000 passengers being handled on 540 suburban trains and 3,000 arriving and departing on 62 through passenger trains, the platforms serving them must be kept clean. The problem of doing so is complicated by the fact that, practically, there is no organization which can be expanded to care for this phase of the work. As an indication that this is not a small matter, there are 63 suburban platforms, averaging about 14 ft. wide and having a total length of 41,777 lin. ft., equivalent to 7.91 miles. The through platforms number 17, with a total length of 11,760 lin. ft., or 2.23 miles.

All but a negligible few, excluding those in the trainshed at Roosevelt

road, have heated waiting rooms at the platform level. Working under the superintendent of suburban service is a small force of porters, who look after the heating plants in the waiting rooms and keep the platforms swept. The sweeping and operation of the heating plants on the through platforms is cared for by the local station employees. At the beginning of a storm, these porters look after the cleaning of the suburban platforms as well as they can until it is possible to organize the necessary maintenance gangs, normally from casual labor. Likewise, the regular maintenance forces clean the through platforms until they can be relieved in the same manner.

Cleaning a Driveway at South Water Street

Heretofore, we have described the organization and the methods employed in keeping switches, driveways, platforms and the coach yard clear of snow. On this terminal, however, are many miles of main and yard tracks which cannot be kept clear by man power or by any of the devices so far described. It is for this reason that the heavier snow-plow and spreader equipment has been provided to avoid the probability that these tracks might be tied up as the result of heavy snowfall, drifting or packed flanges.

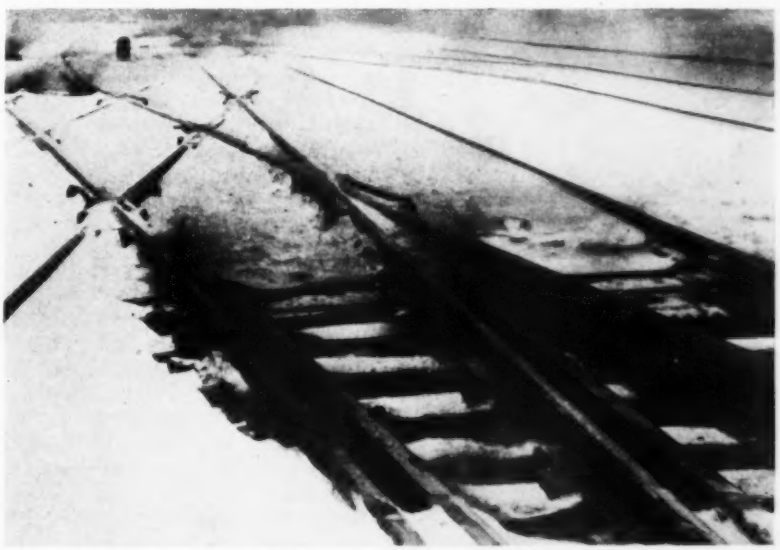
In addition to the four snow plows assigned to the terminal, three wedge plows are stationed at Freeport, Ill., 114 miles west of Chicago, one or more of which can be made available for use on the terminal in case of an emergency. The operators for the snow plows and spreaders are called by the trainmaster, report directly to their machines and remain with them until released. The train and engine crews for handling them are not called until this is requested by the division engineer, however.

Between Van Buren street and Richton, 28 miles, the number of main tracks varies from 6 to 12. It is quite obvious, therefore, that both the snow plows and the spreader which is operated on the main tracks, must be used with a great deal of caution, even when they are employed for flanging only. For this reason only the most experienced operators are allowed to handle them.

Feeding the Men

One of the most interesting phases of the methods employed is the manner in which the men are fed. Long experience has shown that the men work better when they are given substantial meals of warm food. Men for temporary service can also be obtained much more easily when they know that they will be well fed. For this reason, preparation for winter includes arrangements with reliable restaurants adjacent to points where any considerable number of men will be employed, to provide meals for them. Four meal periods, morning, noon, evening and midnight, are established, and so far as practical the men on duty are taken to the restaurants at these hours. However, when organizing gangs of casual labor, unless they are needed in an emergency, they are fed before they are sent out.

As a check on the bills from the restaurants and to insure that only the company's employees who are entitled to meals are fed at the company's expense, foremen are required to accompany their men if possible. If conditions do not permit this to be done, as when only a few men can be spared at a time, they are put in charge of a reliable man who acts for the foreman. The foreman is provided with meal orders in triplicate which must be filled out, showing the date and hour, the number of men and the price of the meals. All copies of these orders must be signed by both the foreman and the restaurant man. The foreman leaves one copy of the signed bill with the restaurant, sends one to the division engineer and keeps one for his own protection. As an additional check, special men are assigned to visit the various restaurants to observe conditions, to see that the food is suitable and ample in quantity, that the prices are in accordance with the agreement and that the foremen and the restaurants are handling the matter in accordance with instructions.



A Double Slip Equipped With Winter King Switch Heaters

Once opened, the headquarters office does not close until the storm is

(Continued on page 785)

Termites in Ro

Left—A Piece of Interior Woodwork Riddled by Termites. Below—What Termites Did to a Building Timber

A FEW years ago, a badly infested sill was removed from a railway building in Galesburg, Ill. The side of the sill, which was exposed to the atmosphere, was in almost perfect condition, but the other side, the top, and the bottom were very badly damaged. I asked the division officer responsible for the maintenance of this building what caused this particular stick of wood to deteriorate. He looked it over and told me that it was badly decayed. I then explained to him the cause of the destruction and showed him live termites in the wood. Since that time, he has been very successful in detecting the presence of termites in various structures, for the maintenance of which he is responsible.

A couple of years ago, our chief engineer issued a circular letter requesting that his office be advised of all buildings or structures in which termites were found. Shortly after this, while on an inspection trip in Wyoming the assistant division superintendent informed me that they did not have termites in Wyoming, although he was familiar with them and their work, and told me in great detail of the damage that they were doing in Florida, where he had recently spent his vacation. During the course of our conversation, it was necessary for us to take a siding to meet a passenger train. While he was telephoning the dispatcher, I dug several hundred live termites out of a wooden sill in the telephone booth. Later I found termites active in our Sheridan, Wyo., roundhouse. In fact, we have reports of termite damage in depots, bridges, roundhouses, stock yards, pump houses, freight houses, water tanks, coal chutes, section houses, telephone booths, ice houses, tool houses and hose houses in Illinois, Iowa, Missouri, Kansas, Nebraska, Colorado and Wyoming.

Not a New Menace

We have heard more about termites as a menace to wooden structures during the last few years than we did previously, creating the impression that they are new in this country or are spreading into areas that had previously been free from them. There is ample evidence, however, that termites existed here long before man. Furthermore, they are not spreading into new areas but are attracting greater attention and causing man to become more conscious of them because of their damage to buildings.

Termites are forest scavengers and their function is to break down and restore the cellulose of wood to the soil and the air in a form that makes it available as plant food, thus completing the cycle of tree growth. It is probable that the reduction in forest areas and the increase in the amount of land under cultivation have reduced the number of termites, but they have also caused them to seek food supply in wooden buildings, bridges, pole lines, etc., where untreated wood is used in contact with or near to the ground. They also destroy old records, books, fire hose, and various other articles in their search for food.

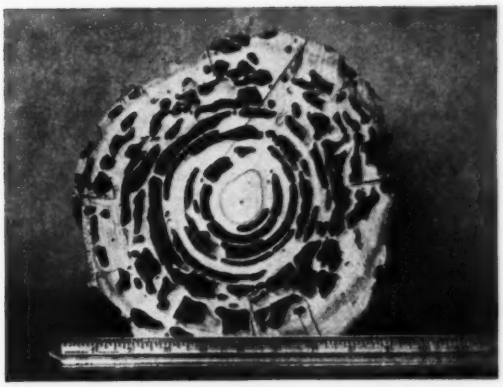
The termites found in the United States may be grouped in two general types, the subterranean or ground-dwelling termites and the non-subterranean or wood-dwelling termites. The non-subterranean or wood-dwelling termites exist in the extreme south, the southwest and the Pacific Coast regions while the subterranean or earth-dwelling termites are found in practically every state in the United States. This type is the most common and is the only one that attacks wood in the territory in which the Burlington railroad operates. Consequently my discussion will be limited to this type.

Subterranean termites build their colonies in the ground or in wood, live or dead, in contact with the

*Abstracted from a paper presented before the convention of the American Railway Bridge and Building Association in Chicago on October 20.

in Railway Structures*

Below—What Dry Wood Termites Did to an Old Joist. At Bottom—Badly Damaged Timber on the Burlington



A description of this enemy of wood, its habits, methods of detection and measures for its control and elimination

By HARRY R. DUNCAN

Superintendent Timber Preservation, Chicago, Burlington & Quincy, Galesburg, Ill.

ground. The cellulose in the wood is their most important source of food but connection between the wood and the ground is necessary for their moisture supply. In the warmer climates, the termites often build their colonies near or on the surface of the ground. However, where the weather is more severe, they usually build their colonies deeper in the ground. I have found that we may expect them where buildings are heated and along steam pipes between buildings, particularly if these pipes should be placed in wood conduit.

In any mature colony, we may expect to find various castes; usually the reproductives (king and queen), soldiers and workers; in addition, there are always present numerous "nymphs" or young in various stages of development. The workers are the destructive form of subterranean termites. They are white, wingless and blind. They shun the open air and are concealed in the earth, in wood, or in shelter tubes.. They require moisture and consequently must maintain contact with the earth, unless an artificial supply of water is available from a leaking water or steam pipe.

The workers' job is to feed the entire colony. They cut the wood, predigest it and feed it to the others. If we examine the interior of the wood in which they are working, the workers scramble to get out of the light and to safety, and the soldiers attempt to close up the openings, which may have been made, so they can protect the balance of the colony, oftentimes even closing up the tubes from the outside with their own bodies.

Naturally, when we are combating such an organization, it is evident that if we remove all termites from the wood in our structure and kill all that are in the wood itself, we can feel fairly certain that there is a colony of them nearby, down in the ground or in an old stump, that is reproducing workers and soldiers to replace any that we have destroyed. Therefore, it is important not only to remove the infested wood in our structures but to take some means of making the wood unattractive to the termites for food.

The winged adults of both sexes emerge to swarm once each year, usually early in the spring. At that time they mate, lose their wings, enter holes or cracks in the earth or in wood and start a new colony. The female soon lays eggs from which the young are hatched. It is during this swarming period that most infestations are recognized or suspected. These winged adults usually have dark bodies and gray wings and,

on the day that they emerge, millions of them may be observed flying in the air or coming out of cracks in buildings or in the ground. They fly but a short distance and lose their wings.

The following day few, if any, of them can be located.

After the colonizing flight and the establishment of the new colony, the termites remain under ground or within the wood or shelter tubes and avoid light and the dry outdoor atmosphere; unless disturbed by outsiders, they do not see sunlight for the balance of their lives. They will build tubes from their colonies through cracks in brick or concrete foundation walls, over treated foundations or along concrete foundations or pipes, until they can gain entrance into wood. Ordinarily it is not necessary for them to build the tubes to great heights in the territory in which the Burlington operates but I have observed tubes in Illinois built up a brick wall to the top of the door sill.

Shelter Tubes of Termites Built on the Post and on Brick Walls in a Building Near San Francisco

How to Locate Termites

The fact that termites do their best work under cover and in darkness contributes materially to the difficulty involved in locating them. They do a great deal of damage to structural members of a building without reducing the strength sufficiently to expose themselves or cause the structure to collapse in ordinary service, although some cases have been reported where a change in the loading has resulted in the collapse of an infested and damaged structure.

To determine the presence of termites, it is important that a complete investigation be made when any of the winged reproductive caste swarm or when runways or tubes are observed. These are two of the easiest ways of detecting their presence. It is important, in territory known to be infested with termites, that all buildings be inspected thoroughly and frequently. In some buildings, such inspection is made every 60 days; in others, every 6 months. I favor a thorough and complete inspection about every 6 months.

This inspection should involve the examination of all wood in contact with the ground or masonry. To accomplish this, it is necessary to remove some of the earth or to dig a trench along the foundation wall. Arrangements should be made to get under the structure and have sufficient light available. Usually artificial light is necessary where termites are working. The tools necessary for this examination are a hammer and a heavy screw driver or chisel. These tools are necessary for the reason that termites usually leave a thin shell on the outside of the wood, although this can be broken into very easily. I look particularly for cracks in the foundation walls and examine all walls carefully for shelter tubes.

This examination, in all cases, should be made on the inside of the building, as this is where the termites are more likely to be present. While they sometimes attack the building from the outside and their presence may be detected, more often it is not possible to detect them from an outside examination of the building. Termites are often located in basements, on walls, under porches or steps, and along interior water, drain or steam pipes.

When making a regular building inspection, I suggest that a thorough examination be made of any wood in the building that has an unusual appearance. Frequently termite infestation is first apparent when the siding near the base of the building appears to curl, crack, or sometimes has the appearance of being decayed. Also, frequently when posts or sills appear to be decayed, further examination reveals the presence of termites. We may also be suspicious of any building in which the floors, sills or joists appear to sag. In one of our own buildings in Illinois, we first became suspicious of the presence of termites by reason of a sagging floor, which was first brought to our attention by the fact that a sectional bookcase did not square up with the balance of the building.

Damage to wooden structures by termites may be avoided if the building is properly constructed and intelligently maintained. On the other hand, a wooden building, constructed in defiance of good building practices, can deteriorate fairly rapidly and be a heavy expense to its owner.

Precautions to Be Observed

In termite-infested territory we should provide methods of keeping subterranean termites from passing to and from the ground where there is moisture and from burrowing into untreated woodwork of buildings. To this end

(1) No untreated wood should be used in foundations, and basement or cellar walls should be concrete.
(2) Cement mortar should be used in masonry foundations.
(3) All masonry foundations should be capped with concrete or cement mortar and slate.
(4) Metal mechanical barriers should be placed over the foundation walls.
(5) Proper ventilation and screening of all ventilation openings and doors should be obtained.
(6) All wooden forms on foundations should be removed from masonry work within 15 days and grading stakes should be removed before the concrete is laid.

In connection with the first recommendation, I have never found a piece of wood which was properly treated and properly used that was damaged by termites. Reports have come to me indirectly of treated wood being destroyed by termites, but I am inclined to believe that this was due to untreated wood being exposed, rather than to the failure of any standard preservative.

Metal mechanical barriers or termite shields, when placed over the foundation walls, are effective termite protectors. They can be made out of 16 oz. hard copper strips and should cost about 15 cents a lineal foot installed. It has been estimated that complete provision for termite-proofing buildings, including shields, at the time of construction, increase the cost of a building from one to two per cent.

To protect an existing structure against termites, no untreated wood

should be used in contact with the ground, adequate ventilation should be provided, and all openings in walls, regardless of the material used in their construction, should be closed so that termites cannot gain entrance into the building. This means that there should be no wood in foundation walls; all mortar should be in good condition; all cracks in concrete should be sealed up, and basement floors should be repaired so that it will not be possible for termites to gain access to the wood in the structure through cracks.

If any wood is in contact with the ground, it should be treated in an approved manner with standard chemical preservatives. This will make the wood undesirable to the termites for food. After a building is constructed or repaired, it is of the utmost importance that all wood debris be removed from beneath and around the building. Many authorities maintain that this particular phase of termite prevention work cannot be emphasized too strongly.

Eliminating Termites

We have located termite infestation in a number of our buildings. Usually our plan has been to replace the damaged members of the structure with treated wood; remove all types of termite food supply from the ground beneath and around the building; make certain that all masonry is in good condition, and we have, in some cases, dug a trench around the wall and poured creosote in the trench. We probably have had termite infestations for many years, although the oldest record which we have is about eight years. This particular structure is an old one which we are considering replacing and no replacement of the termite-damaged material has been made. While the building is inspected three times each year, no evidence of termites has been observed for six or seven years.

There is no evidence that termites will continue to enjoy any one source or kind of food. I have observed places where they pass over some wood which apparently should be entirely satisfactory to them, to get to some other wood that they apparently want.

We have located a number of test specimens of untreated wood and wood treated with certain proprietary compounds at various places on our property. At two locations in the Republican River valley in Nebraska, where termite infestation has been very severe, we have untreated control specimens and treated specimens. I examined these once each year during 1932, 1933 and 1934 and each time the treated ones were sound and free from termites, while the untreated ones contained many termites and the destruction was progressive each year. Yet our 1935 and 1936 inspections indicated that no termites were present in the test specimens in either location. You will recall that we had a very severe flood in the Republican valley early in June, 1935. It is probable that there is a relation between this flood and the fact that termites have not since been found in these untreated specimens, as they had been in previous years.

We have had few cases of termites in our bridges. In most cases, the wooden bridge material on our railroad is treated. It has also been my thought that there is sufficient food supply for termites so that it is not necessary for them to build tunnels from the ground on to a bridge, which vibrates so much that the tunnels will likely be broken and will have to be replaced frequently. I have, however, found a few cases where termites have worked, particularly in untreated material used for bulkheading. This is usually replaced with treated or concrete material and no further damage occurs.

Winter's Challenge

(Continued from page 781)

over and all extra men are released and paid. As has been stated, independent and direct telephone communication is established with every point on the terminal, that is, with all towers, all yard offices, the dispatcher, the trainmaster, the engine terminals and with numerous other points. In this way reports are being received constantly as to conditions at all important points.

It has been found, however, that this is not always sufficient, for there are numerous isolated places where telephones cannot be established, such as platforms, driveways and distant points in yards. For this reason, a number of selected men are assigned to travel from place to place, to see the various gangs, to talk with train and switching crews and to observe conditions on the ground. The information thus obtained is transmitted at once to headquarters, whether favorable or unfavorable.

How Men Are Paid

To pay the casual labor, a special pay-roll staff is set up in the headquarters office. This staff does not handle the rolls for the regular forces, as they are handled in the usual way. So far as is consistent, no gang is allowed to work more than 10 hours. At the end of each working period, the special time book for each of the gangs is turned over to the pay-roll staff which checks it and prepares the special pay rolls, a separate roll being written for each gang. As the men go out in these extra gangs they are given numbers and identification cards.

Payment is made daily at 11 a.m. all gangs that have been released up to and including 7 a.m. of any day being able to get their pay at that hour. Gangs released after 7 a.m. are paid at 11 o'clock the following day. The foremen are required to be present and to assemble their men in groups in the line before the paymaster's window. To get his pay a man must not only have his identification card but he must be identified by his foreman. The percentage of those who fail to appear at this hour is surprisingly small.

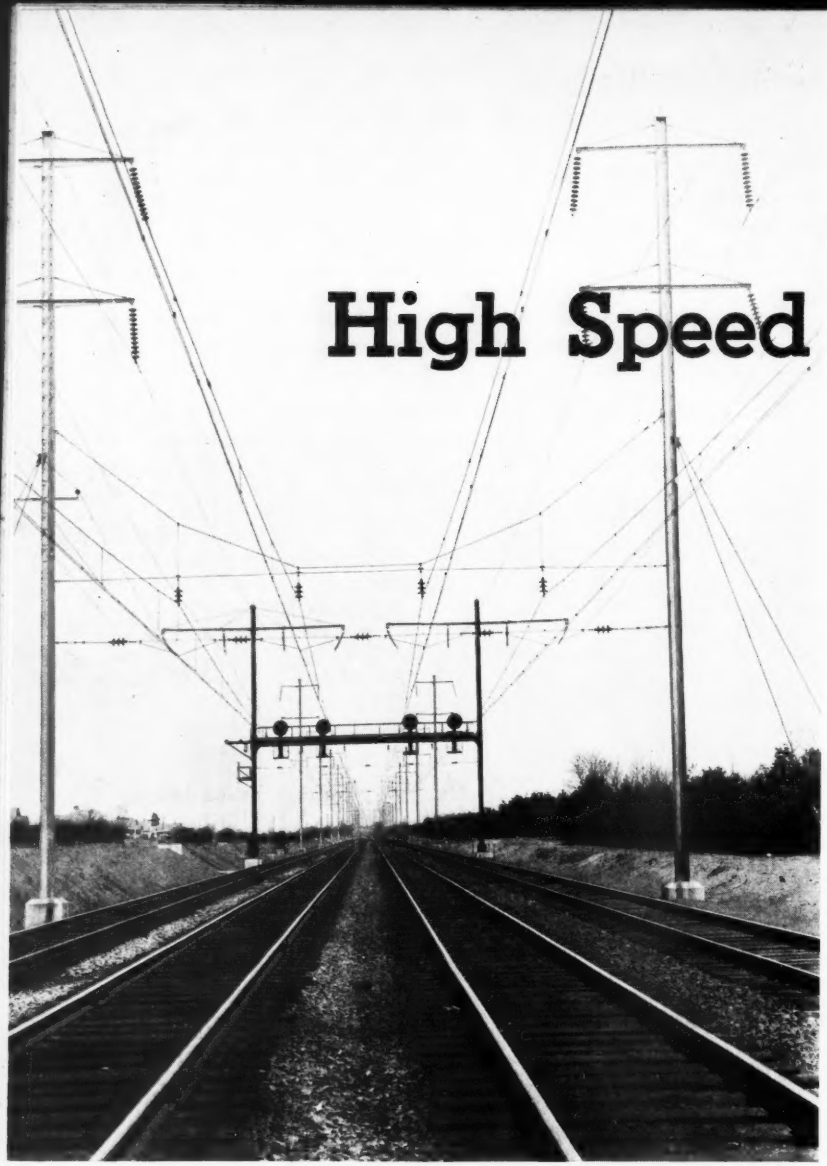
Careful Planning Essential

It is quite obvious that in a terminal of the magnitude and intensive traffic which characterize the Chicago terminal of the Illinois Central, careful planning, adequate preparation and a properly directed organization are essential to coping successfully with winter conditions. That these requirements are met by the methods followed and the equipment used is confirmed by the fact that this terminal has been tied up only twice in 40 years, once in the early winter of 1903 as the result of a severe sleet storm and again during the disastrous storm in January, 1918, when traffic was paralyzed all over the middle west. In both of these cases, however, the storms were too severe for it to be humanly possible to combat them, particularly since the modern aids to fighting sleet and snow were not then available so that entire reliance had to be placed in hand methods.

Furthermore, as a measure of the effectiveness of the snow-fighting equipment which is being used on this terminal, particularly that for heating switches and for loading accumulations of snow, it was formerly necessary to employ from 1,500 to 2,000 casual laborers during a 24-hour period, whereas at present not more than 500 are necessary, even during the worst storms. It should be understood, moreover, that this number includes the extra men necessary to relieve the regular forces for rest and from 50 to 60 men employed in cleaning platforms throughout the terminal.

High Speed Track—How G

Extensive tests on the Pennsylvania to develop fast electric locomotive prove that permissible speed depends largely upon surface and cross-level



Typical Track in Electrified Territory on the Pennsylvania

IN SPITE of the lack of extensive test data bearing on the subject, most railway maintenance officers have long held the general belief that rough track, high axle loads and high-speed operation are responsible for excessive lateral wheel blows on the rail, which in turn tend to throw the track out of line. This belief has now been substantiated in an extensive group of tests conducted by the Pennsylvania, which indicate conclusively that the magnitude of the lateral blows of locomotive wheels on the rail is largely a function of the condition of the track, the driver axle loads and the speed of operation. One of the striking facts brought out by the tests in this regard was, however, that while increased roughness of the track and increased axle loads cause largely increased lateral blows on the rail, regardless of the type of power, these forces, for the different types of locomotives, do not necessarily increase in magnitude rapidly with increases in speed of operation.

As a matter of fact, whereas increased speed with certain types of locomotives over a given piece of rough track caused largely increased lateral forces on the rail, high speeds of certain other types of locomotives over the same piece of track showed only small increase in the lateral forces on the rail. Summarizing the tests as a whole, it would appear that the secret of low lateral forces on the rail is good track line and surface, and properly designed locomotives with well-distributed axle loads.

Tests Extensive

The tests referred to were conducted primarily in connection with the development by the Pennsylvania of electric locomotives for its recently inaugurated high-speed electric operation between New York and Washington, D. C. Directly, or indirectly, these tests were intended to throw light on numerous features of locomotive design, but their primary purpose, at the outset, at least, was to develop a locomotive with the operating characteristics desired, which would produce minimum lateral thrust on the rails at high speeds, and thus, one which would have a minimum tendency to throw the track out of line.

In the tests, which involved a special section of test track designed to measure the lateral thrusts on the rail produced by the operation of different types of locomotives at various speeds, or by the same general type of locomotive with modifications in design, the Pennsylvania operated 11 different types of locomotives, both steam and electric, and made approximately 1,800 test runs. As a direct result of the test, the road developed and adopted the GG1-type electric locomotive, 58 of which are now in service, as the one which had the operating characteristics desired while producing a minimum tendency to force the track out of alinement at high speeds under the most adverse track conditions that might possibly be encountered.

This article will not be concerned with the locomotive selected and its

ow Good Must It Be?

In connection with the design of its high-speed streamlined electric locomotives for operation between New York and Washington, D. C., the Pennsylvania conducted extensive track tests to insure that the locomotive which it would build would not only have the most desirable operating characteristics, but would also hold to a minimum the lateral thrusts on the rail that tend to throw the track out of line. In addition to accomplishing their purpose, these tests, which are described in this article, showed conclusively that one of the most important factors in minimizing the cause and magnitude of lateral thrusts is to keep the track in good surface and cross-level.

special features of design, but rather with the testing equipment employed in the track to measure the lateral pressures on the rail, and the results produced by the tests, which are of particular interest to maintenance of way department forces.

Elaborate Track Equipment

The tests were carried on during 1933 and 1934 on the Maryland division, near Claymont, Del., in a section of the road's No. 4, or southward passenger track. The specific test section, which extended over a distance of 440 ft., was located in a well-maintained portion of the main line equipped with 130-lb. Pennsylvania section rail, large treated ties, large tie plates and a substantial section of stone ballast. Within the test section itself, the wood ties were removed and the rail was relaid on 249 specially constructed steel ties, every second one of which, called a recording tie, was fitted with apparatus to record the magnitude of the lateral thrusts exerted on the rail at that point. The apparatus used was essentially an adaptation of the Brinell hardness testing apparatus, in which the impression of a hardened steel ball in a material under a given impact is a direct indication of the hardness of the material. However, in this case, the hardness of the material was constant, and the depth of impression was used to indicate the magniture of the force causing it.

Both ends of each of the recording ties were equipped with horizontal plungers which were free to move longitudinally in bearings and which pressed against the outer sides of the rail heads. At the outer end of each plunger was placed a hardened steel ball, one inch in diameter, against which was set a piece of annealed boiler plate held by a suitable bracket. This piece of boiler plate, called the impression plate, was brought into contact with the ball by a second plunger, which was brought up to snug contact behind the plate by means of a wedge driven in a slot near the rear of the assembly casting.

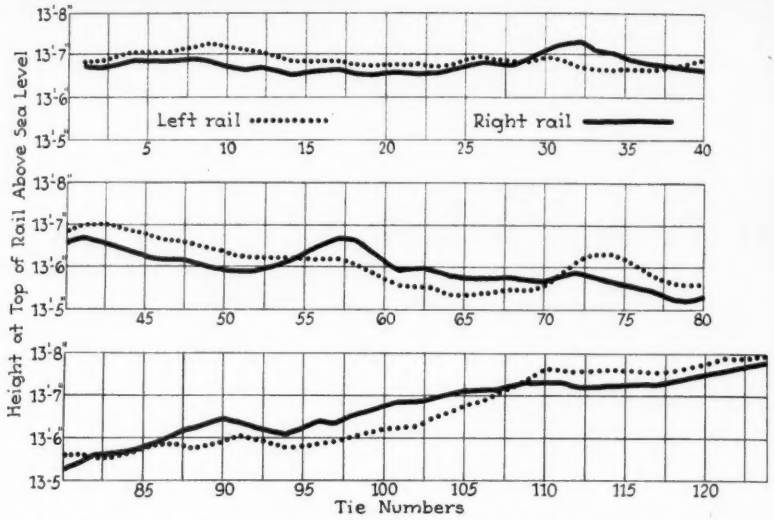
With this apparatus, when a locomotive passed over the track, the lateral blows from the wheels on the rail forced the hardened steel Brinell ball into the soft steel impression plate, the depth of the depression being directly proportional to the force causing it. This proportion was approximately 0.01-in. depression for each 4,750 lb. lateral blow. Thus, for example, as noted on the accompanying charts, a 0.05-in. depression represented a lateral blow of approximately 23,750 lb. In order that the full lateral pressure might be recorded by the plates, undiminished by the frictional resistance of the rail on their bearing plates, the rails, at both recording and non-recording ties, were supported on nests of roller bearings which offered negligible resistance to their lateral movement.

A particularly desirable feature of the Brinell track apparatus was that the depth of the depression, regardless of the number of repeated blows of varying magnitude, represented only the maximum blow, being the

General View of the Brinell Test Track Near Claymont, Del., Showing the Test House at the Left

same as though the maximum blow had acted alone. Thus, following a test run of a locomotive, measurement of the depth of impression of all the balls in all of the impression plates disclosed at once the points of maximum lateral thrust on the rails and the magnitude of these thrusts.

The speed of operation over the test track while making records was measured by means of special locomotive-tripped circuit breakers located along the track, which were connected electrically to a chronograph located in a test house directly alongside the section of test track. Thus, with the greatest accuracy, speed of operation was recorded for each test run.



Profile of Brinell Test Track as Maintained Throughout Most of the Tests—Elevations Are of Top of Rail Under the Middle Driver of the P5A Locomotive Tested

Types of Power Tested

The locomotives involved most extensively in the tests included what are known as the P5A, the R1, and the GG1 electric locomotives, although, for comparative purposes, several other locomotives were tested, including a New Haven electric locomotive and a K4s steam passenger locomotive. The initial object of the tests was to measure the lateral forces on the track produced by the Class P5A electric locomotive, a number of which had been built by the Pennsylvania, and to determine what changes in its design would minimize the magnitude of these lateral forces which, under certain conditions of high speed, had shown an adverse effect on the track.

The Class P5A locomotive has a 2-C-2, or, in the White system, 4-6-4, wheel arrangement; a rigid wheelbase of 20 ft. 0 in.; an over-all length of 62 ft. 8 in.; a sustainable horsepower of 3,750 at the rail; and a maximum normal permissible speed of 90 m.p.h. Its total weight at the time of the tests was 386,000 lb.

The Class R1 locomotive has a 2-D-2 (or 4-8-4) wheel arrangement, and was generally similar to the P5A, except that it had one additional pair of driving wheels, a longer wheelbase, additional weight and greater horsepower. It had a rigid wheelbase of 23 ft. 0 in.; an over-all length of 64 ft. 8 in.; a sustainable horsepower at the rail of 5,000; and a maximum normal permissible speed of 100 m.p.h. Its total weight was 402,000 lb.

The Class GG1 locomotive which was tested is an articulated unit with a 2-C-C-2 (4-6-6-4) wheel arrangement; a rigid wheelbase of 13 ft. 8 in.; and an over-all length of 79 ft. 6 in. It has 4,620 sustainable horsepower at the rail; weighs 475,000 lb.; and has a maximum normal permissible speed of 100 m.p.h.

Both the R1 and the GG1 locomotives were designed and built after initial tests had been made of the P5A, and in both were incorporated features found to be desirable for high speed operation as a result of the tests. One of each of these locomotives was constructed specifically for experimental use.

The K4s steam locomotive, which was run over the test track largely for comparative purposes, has a 4-6-2 wheel arrangement; a rigid wheelbase of 13 ft. 10 in.; and an over-all length over engine and tender of 80 ft. 6¾ in. It has a tractive effort of 44,460 lb., with 201,830 lb. on drivers.

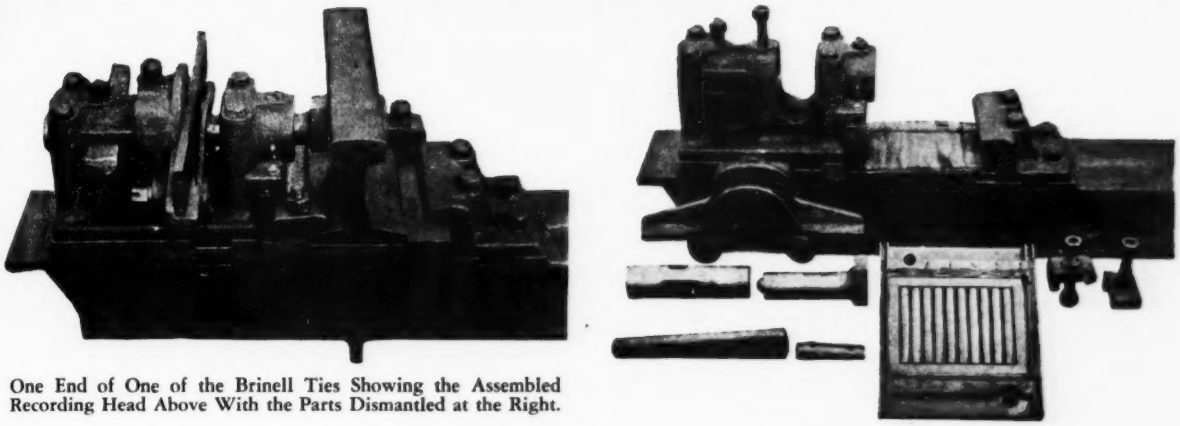
In its early attempts to determine the locomotive which would produce minimum side thrust on the rail at high speed, or, in other words, the locomotive which could be operated the most safely at high speeds, the Pennsylvania found that the forces could not be measured satisfactorily on smooth track. This was because on such track the lateral blows on the rail produced by even the least satisfactory locomotives were relatively light, and did not afford a good comparison with blows produced by locomotives of other characteristics.

When the test track was first installed, it was given good line and surface. When the original class P5A electric locomotive, the one in which it was desired to make improvements, was run over this track at speeds up to nearly 100 m.p.h., only relatively light lateral blows were recorded, not exceeding 12,000 lb., which were far from sufficient to distort the track. This situation is shown in the lower curve in Chart I. In this lower curve, it is interesting to note also that, on smooth track, the magnitude of the lateral blows increased very gradually with increases in speed, being only approximately twice as great at 100 m.p.h. as at 55 m.p.h., and still relatively small, even with this type of locomotive which had shown some tendency to be hard on the track.

One of the Impression Plates Showing Indentations Made by the Brinell Ball

In view of this situation, and the belief that it would be most effective to compare locomotives under conditions where they produced heavy lateral blows on the track, knowing that under normal operation the locomotives are bound to encounter track conditions at times which will cause them to exert more or less heavy blows, depending upon their characteristics of design, it was decided to roughen the test track. This was done.

At first there was no way of knowing how rough the test track should be to represent the poorest piece of



One End of One of the Brinell Ties Showing the Assembled Recording Head Above With the Parts Dismantled at the Right.

main line track that may be encountered by a locomotive at high speed. Neither was it known how rough the track might be before distortion would be caused by lateral blows produced by high-speed operation. Therefore, roughening of the track was undertaken carefully, the intention being to incorporate only enough unevenness of surface to make it possible to determine the differences in maximum permissible speeds between the original P5A, the K4s steam locomotive, and the other electric locomotives incorporating trial changes, without in any case exceeding a speed of 100 m.p.h. in the tests.

At first, irregularities in the surface of the test track were effected by tamping and consolidating the ballast at certain points, producing a few rough or hard spots. Before many test runs had been made with the P5A electric and the K4s steam locomotives, however, the track was given a number of humps from ⅛ in. to ¼ in. high, as measured with a level while unloaded. Under this condition, the maximum depth of impression produced on the test plates by the operation of the P5A over the track at 102 m.p.h., was 0.045 in., representing a blow of approximately 21,000 lb.

Desiring to produce still greater lateral blows for comparative purposes, and recognizing that the roughness of the track, and, therefore, the effect on the equipment, depends not alone upon the height of high spots or the depth of low spots, but also upon the cross-level of the track and the rate of runout of high or low spots, further roughening of the track was effected early in the tests. In effecting this, three distinct humps were put in the right-hand rail and four in the left-hand rail. The height of these humps, their location and the degree of their abruptness under the load of a P5A locomotive, are shown in the accompanying profile of the Brinell track. Each measurement plotted on this profile was made under the middle driver of the locomotive.

Throughout the tests, these humps were maintained in the track as accurately as possible by trackmen, checked in their work by a surveyor's level. In addition, in order to insure an exact basis of comparison between the various test runs on different days, an original Class P5A locomotive was run over the test track each day. Through these runs, the degree of roughness was indicated closely by the speed at which this locomotive produced a 0.05-in. maximum depression in the impression plates, corresponding to a lateral force against the rail of approximately 23,740 lb. Normally, throughout the tests of the various locomotives, the speed of the test runs was not carried beyond that which, in the case of each locomotive, produced impressions of 0.05 in., because at this point the depth at impression, and, therefore, the magnitude of the blows, was increasing rapidly for small increases in speed, at least in the cases of certain of the locomotives, and it was evident that these locomotives had nearly reached the speed at which they would actually cause displacement of the roughened track.

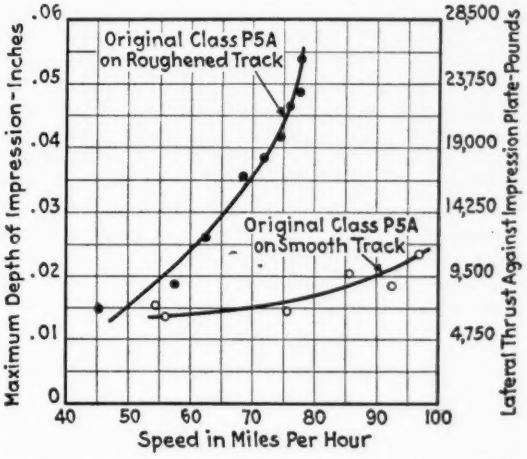


Chart I—Record of Lateral Forces Caused by the Original P5A on Smooth and on Rough Track

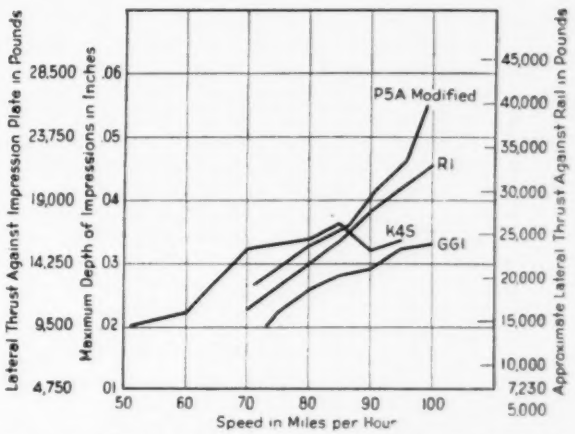


Chart II—Showing How, Generally, the Magnitude of Lateral Blows on the Rail Increased With Speed, Depending Upon Features of Locomotive Design

As a result of the extended track tests, the Pennsylvania developed, tested and adopted numerous improvements in electric locomotive design, which were embodied in the GG1-type locomotive agreed upon as best meeting the requirements of electric operation, while subjecting the track to minimum abuse.

While many features involved in the tests and many of the results found are of primary interest to motive power men concerned with developing heavy-duty high-speed locomotives which will have the desired operating characteristics and will, at the same time, be "easy" on the track, there were several factors brought out clearly which are of special interest to those charged with the construction and maintenance of the track. The first of these is the relation of the surface and cross-level of the track to the abuse which it sustains; the second is the relation of speed to the magnitude of the lateral thrusts; and the third is the relation of axle loads to lateral thrusts.

The first point is illustrated most effectively in Chart I, which shows graphically the relation of speed to lateral blows on the rail in the case of test runs made by the original Class P5A locomotive on roughened track and also on smooth track. This chart shows that whereas on smooth track the lateral blows on the rail caused by this locomotive increased in magnitude only moderately with increases in speed up to approximately 100 m.p.h., being well below any danger point at the highest speed, the magnitude of the lateral blows on the rail in the roughened track increased out of all proportion to the speed, reaching limits at approximately 78 m.p.h. which indicated that at slightly higher speed the track would be displaced.

Throughout the long series of tests, the maximum safe speed of the P5A increased or decreased with the degree of roughness of the track, and always at the higher speeds the curve of maximum lateral forces was nearly vertical. The action of all of the locomotives tested, including the K4s steam locomotive and the GG1 with its many advantageous features and refinements, proved that on good track there is a minimum tendency for locomotives, almost regardless of design, to exert damaging lateral blows on the rail, even when operating at high speeds.

The action of the P5A as modified, the R1, the K4s and the GG1 on the roughened track at various speeds is shown on Chart II. Here it is seen that for all of the locomotives, the magnitude of the lateral blows on the rail increased quite considerably with speeds up to approximately 85 m.p.h. Above that speed, the force of the blows increased rapidly or slowly, depending entirely upon features of design of the locomotives, being a minimum in the case of the GG1 locomotive with its many features to minimize weaving or nosing of the driver trucks.

As regards the effect of the weight on the drivers in producing lateral blows on the rail, it was observed in the tests, as shown in Chart II, that the lateral forces produced by the modified P5A, the R1 and the GG1, were in the order of their static driving axle loads. These axle loads are approximately 75,000 lb. for the modified P5A, 60,000 lb. for the R1, and 50,000 lb. for the GG1.

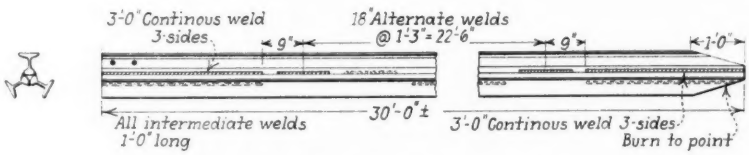
Summarizing these facts, the tests appear to have established that, in general, the weight of the axle loads affects the magnitude of the lateral blows on the rail; that, almost regardless of the class or type of power, track that is not well maintained in surface, cross-level and line is subject to greater abuse than smooth track, at least at speeds above 45 or 50 miles an hour, the speeds at which measurements were taken; and that, generally speaking, particularly on rough track, the lateral blows sustained by the rail increase with the speed of operation, being rapid to the danger point in the case of some types of locomotives, and much less rapid, with other, better-designed types of power.

Make Steel Piles From Scrap Rails

WHILE the use of steel bearing piles cannot be justified in most locations on account of their greater cost, compared with piles of other materials, there are situations where the driving is so hard that steel piles are the only kind that can be driven or where the cost of driving steel piles is so much less as to offset the greater cost of the piling. This is true especially where it is necessary to drive piles to great depths to obtain security against scour. Steel piles were also found of particular advantage in two structures built recently on the Chicago, Rock Island & Pacific, where it was necessary to drive them through an old embankment to reach supporting material below the original ground surface, these piles serving as the support for bank blocks.

The imperative need for curtailing the cost of the work on these two bridges led to studies of the possibility of fabricating piles from scrap rails, and while these did not show any saving compared with the cost of standard section steel piles, it was decided to use the scrap rail piles because they could be produced for an appreciably smaller actual cash outlay than was required for the purchase of steel piles commercially available.

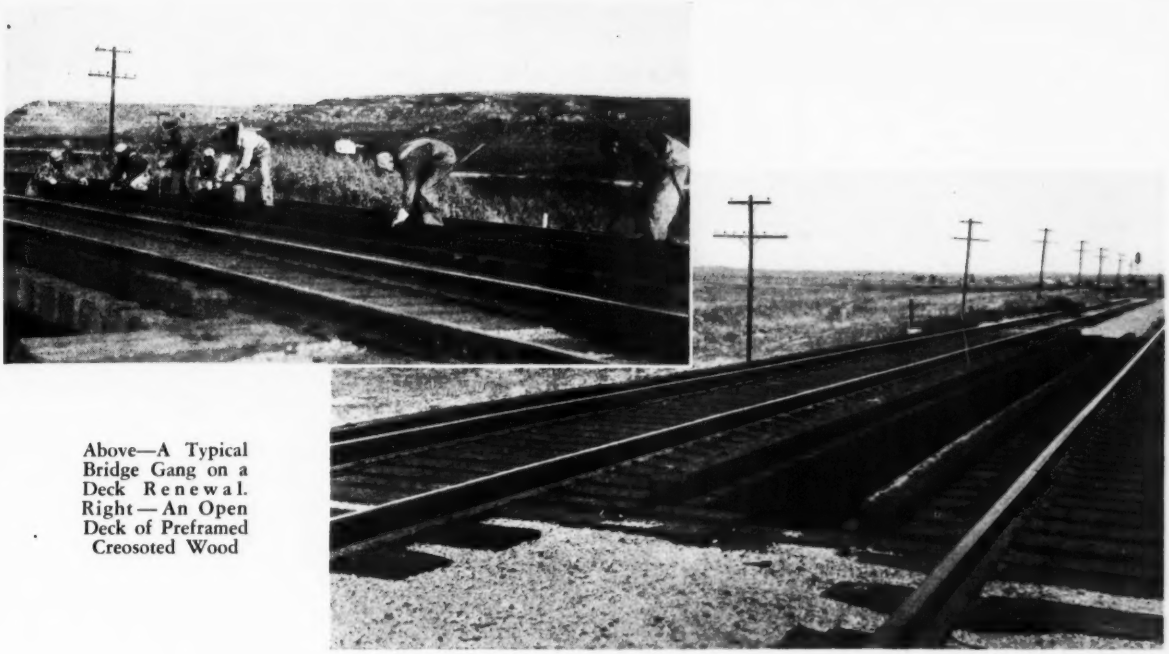
As shown in the sketch, the piles are formed by assembling three 100-lb. rails with their heads together in a star shape, and connecting the heads by ⅝-in. bead (arc) welds. Rails of 80-lb. and 90-lb. sections have been used in other cases. These welds are continuous at all three lines of contact for a length of three feet at each end, while in the intervening distance there is a bead one foot long at 3 ft. 9 in. centers in each line of contact, the welds on the three lines being staggered. The work was done with the aid of jigs consisting of steel plates cut in the shape of a circle and having holes cut in the center conforming to the pattern of the three-rail assembly. Slipping these jigs over the ends of the three rails not only holds them in correct position but also makes it possible to roll the assembly into position for the flat welding of all beads.



Drawing Showing Details of the Scrap Rail

A point is provided on one end of the piles by flame-cutting the bases and webs of the rails on a bevel from

(Continued on page 794)



Above—A Typical Bridge Gang on a Deck Renewal. Right—An Open Deck of Preframed Creosoted Wood

Union Pacific

Adopts New Methods

in Bridge Maintenance and Renewals

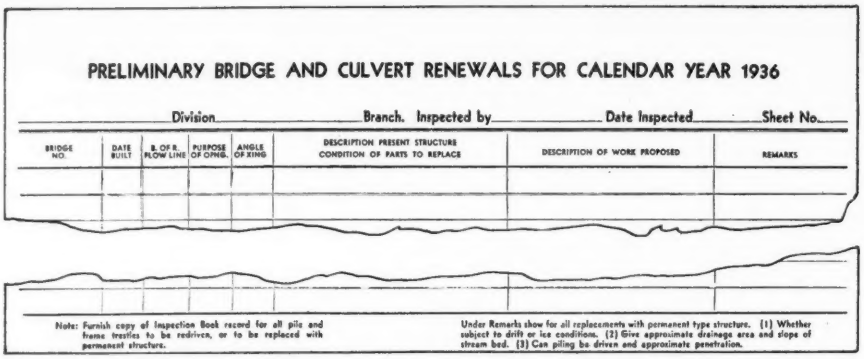
Some 10 years ago the Union Pacific Railroad commenced the programming of its bridge maintenance and renewals, and this proved so successful that the plan was extended five years later to embrace the complete scheduling of the work of individual gangs. Shortly thereafter a beginning was made in preframing which was eventually extended so that the practice is now applied to almost all timbers used in bridges and trestles. The system under which programming, scheduling and preframing are carried on as a co-ordinated procedure comprises the subject of this article.

TREATED timbers used in the construction or reconstruction of wooden trestles, the decks of trestles, and the ties and guard timbers of steel bridges on the Union Pacific Railroad are framed and bored before treatment, this work being done with a degree of accuracy that precludes almost entirely the cutting of the timber in the field The procedure under which that practice has been put into effect was developed in such a way as to entail no deviation from the plan for the complete programming of all bridge work which has been followed on the Union Pacific for the past five years. An exposition of the preframing methods, therefore, involves an explanation of the manner in which the bridge repair and renewal program is prepared and the work of the various gangs is scheduled.

All work authorized and carried out is founded on the annual bridge inspection, which is made during spring and summer for work to be done during the ensuing year, by the system bridge inspector in company with the division engineer, or the supervisor of bridges and buildings, or both. The observations made in the inspection are recorded in an inspector's notebook and these data are the basis for all subsequent action. Designed especially for recording information concerning pile trestles, the ruled pages provide spaces for noting the diameter and condition of each pile in every bent as well as the condition of the caps, stringers and other material, but ample space is provided for statements concerning the condition of other classes of structures. The recommendations of the inspection party as to the nature of the work required to correct defects observed are entered in a "Remarks" column in the notebook.

Two Tabulations

These recommendations are assembled in two separate tabulations. Those involving repairs to structures are entered in a Statement of Repairs to Bridges and Culverts, pre-



PRELIMINARY BRIDGE AND CULVERT RENEWALS FOR CALENDAR YEAR 1936

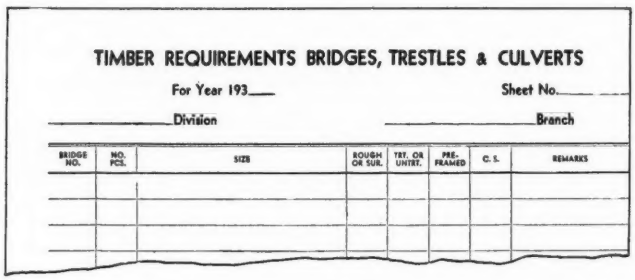
Division Branch. Inspected by Date Inspected Sheet No.

BRIDGE NO.	DATE BUILT	B. OF R. FLOW LINE	PURPOSE OF OPNG.	ANGLE OF XING	DESCRIPTION PRESENT STRUCTURE CONDITION OF PARTS TO REPLACE	DESCRIPTION OF WORK PROPOSED	REMARKS

Note: Furnish copy of Inspection Book record for all pile and frame trestles to be redriven, or to be replaced with permanent structure.

Under Remarks show for all replacements with permanent type structure. (1) Whether subject to drift or ice conditions. (2) Give approximate drainage area and slope of stream bed. (3) Can piling be driven and approximate penetration.

Left — Form Used by the System Bridge Inspector for Recommended Renewals Below — Inspector's Form for Indicating Timber Requirements



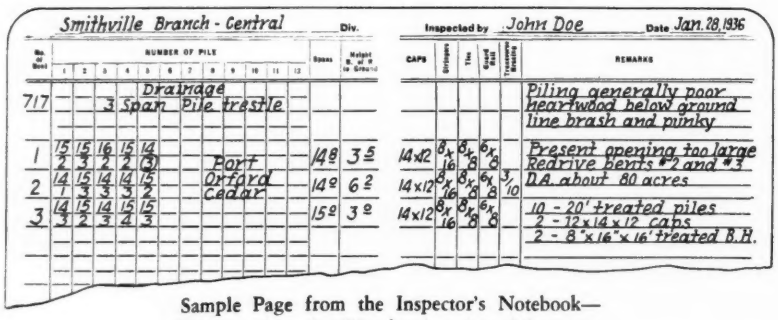
TIMBER REQUIREMENTS BRIDGES, TRESTLES & CULVERTS

For Year 193— Sheet No.

Division Branch

BRIDGE NO.	NO. PCS.	SIZE	ROUGH OR SUR.	TRT. OR UNTRT.	PRE. FRAMED	C. S.	REMARKS

pared by the divisions and forwarded through the district engineers to the chief engineer, while those calling for the renewal or replacement of structures are tabulated by the system bridge inspector on a form known as "Preliminary Bridge and Culvert Renewals for the Calendar Year 193—," a copy of the report being sent to the divisions. These two statements comprise the basis upon which the annual bridge budget is determined. The System Bridge Inspector also prepares from his notebooks a "Statement of Timber Requirements," the purpose of which will be described later in this article.



Smithville Branch - Central Div. Inspected by John Doe Date Jan. 28, 1936

No. of Bent	NUMBER OF PILE 1	2	3	4	5	6	7	8	9	10	11	12	Spans	Height B. of R. to Ground	CAPS	Stringers	Ties	Guard Timbers	Transverse Bracing	REMARKS
						Drainage														Piling generally poor heartwood below ground line brash and punky
7/7			3	Span		Pile trestle														
1	15 2	15 3	16 2	15 2	14 3			Fort					14	3 5	14x12	8x 16	8x 8	6x 8		Present opening too large Redrive bents #2 and #3
2	14 1	15 3	14 3	14 3	15 2			Orford Cedar					14	6 2	14x12	8x 16	8x 8	6x 8	3/10	D.A. about 80 acres
3	14 3	15 2	14 3	15 4	15 3								15	3 0	14x12	8x 16	8x 8	6x 8		10 - 20' treated piles 2 - 12x14x12 caps 2 - 8"x16"x16' treated B.H.

Sample Page from the Inspector's Notebook— Entries Given Are Not for Any Actual Structure

Work to Be Done

Following the approval of the budget, the bridge engineer's office prepares a schedule of bridge work to be done on each division, showing in detail the work to be done, the number of gang-days required for each job and the specific dates on which each job is to be started and completed. The portion of this schedule relating to repair items is based on the Statement of Repairs prepared by the divisions, on which the estimated man-days and the labor cost are shown for each item. The part of the schedule relating to renewals is prepared from information developed in the bridge engineer's office. Obviously this schedule cannot anticipate the demands made on the bridge gangs for emergency work, and if a gang gets behind schedule due to having been taken off temporarily for emergency work it, of course, runs late on the schedule.

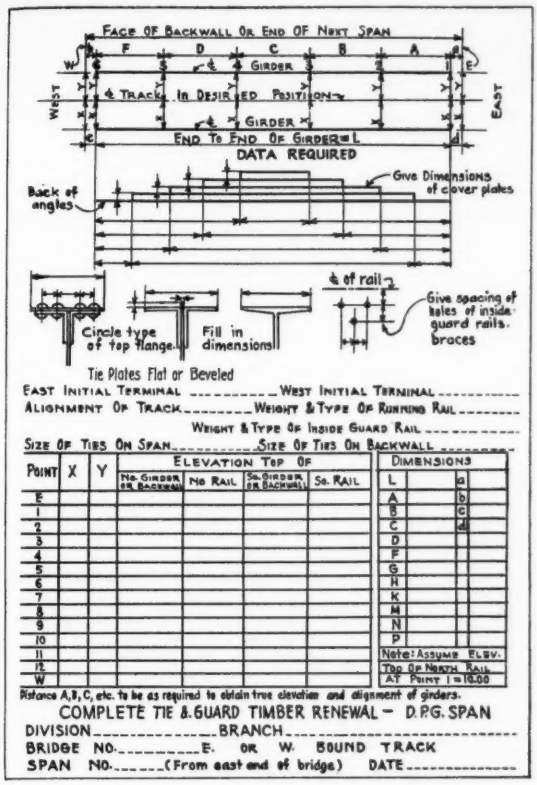
Because the timber for the bridge work must be treated, it is necessary to order the timber as promptly as possible. For this reason, the bridge inspector is required to tabulate the timber requirements without delay on a form provided for that purpose. This form, which shows the number of pieces of each size required for each job, is used in the preparation of a tabular statement on which the number of pieces of each length for sticks of each size are recorded, one sheet being used for each size. The tables also show the number of pieces to be treated and framed and to be used untreated. A summary tabulation shows the material segregated as between the four districts of the system, the material on hand, the amount to be purchased and the surplus.

Preframing involves the preparation of detail drawings of all pieces required. In the case of the complete renewal of a pile trestle or of timbers for the deck of a new steel bridge, such plans are readily prepared from the standard trestle plan or the plans for the steel span. However, for the renewal of the ties and guard timbers on an existing steel structure or a trestle, or the renewal of the complete deck of a trestle, it is necessary for survey parties to take accurate measurements in the field in order that the new timber may be detailed with the degree of accuracy necessary for preframing.

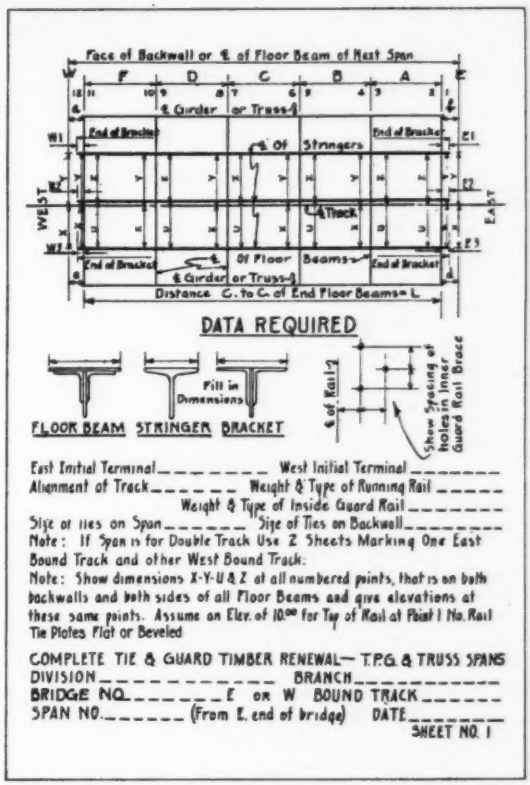
To insure uniformity in the method of recording the measurements, to obviate the need for special field sketches, and to insure that no dimensions are overlooked, four standard forms have been developed which indicate by tables and sketches all the data that are to be taken in the field. One of these forms covers the complete renewal of a trestle deck, two others the renewal of the ties and guard timbers of a trestle and of a deck girder span, and a fourth the renewal of the ties and guard timbers of through plate girder or truss spans. As these forms have been designed to cover almost every conceivable condition to be encountered, it is only in rare instances that it is necessary to fill in all the dimensions in taking the required data for an individual structure.

Line Adjustment

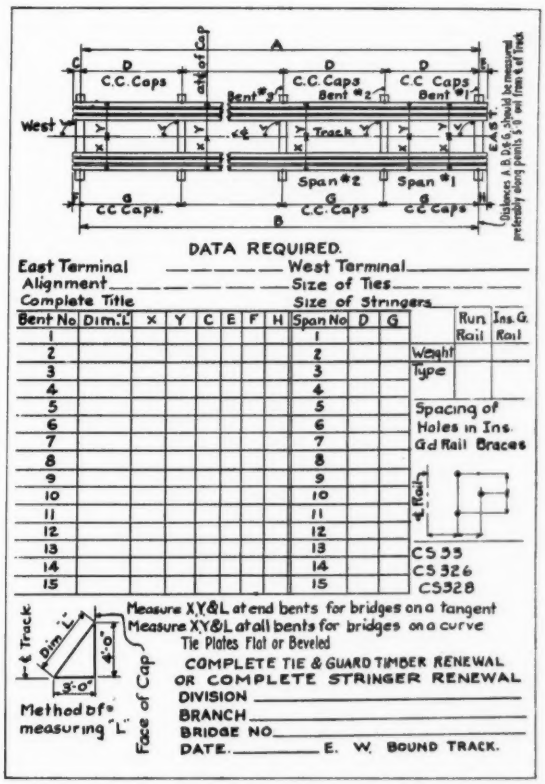
The standard design of pile trestle which has been developed by the Union Pacific to facilitate prefram-


FACE OF BACKWALL OR END OF NEXT SPAN
F D C B A
GIRDER
℄ TRACK IN DESIRED POSITION
WEST
EAST
END TO END OF GIRDER = L
DATA REQUIRED
Back of angles
Give Dimensions of cover plates
Circle type of top flange
Fill in dimensions
℄ of rail
Give spacing of holes of inside guard rails. braces
Tie Plates Flat or Beveled
EAST INITIAL TERMINAL _____ WEST INITIAL TERMINAL _____
ALIGNMENT OF TRACK _____ WEIGHT & TYPE OF RUNNING RAIL _____
WEIGHT & TYPE OF INSIDE GUARD RAIL _____
SIZE OF TIES ON SPAN _____ SIZE OF TIES ON BACKWALL _____
POINT X Y ELEVATION TOP OF: No. GIRDER OR BACKWALL, No. RAIL, So. GIRDER OR BACKWALL, So. RAIL
DIMENSIONS: L, a, b, c, d
E 1 2 3 4 5 6 7 8 9 10 11 12 W
A B C D F G H K M N P
Note: ASSUME ELEV. TOP OF NORTH RAIL AT POINT 1 = 10.00
Distance A, B, C, etc. to be as required to obtain true elevation and alignment of girders.
COMPLETE TIE & GUARD TIMBER RENEWAL – D.P.G. SPAN
DIVISION _____ BRANCH _____
BRIDGE NO. _____ E. OR W. BOUND TRACK
SPAN NO. _____ (From east end of bridge) DATE _____

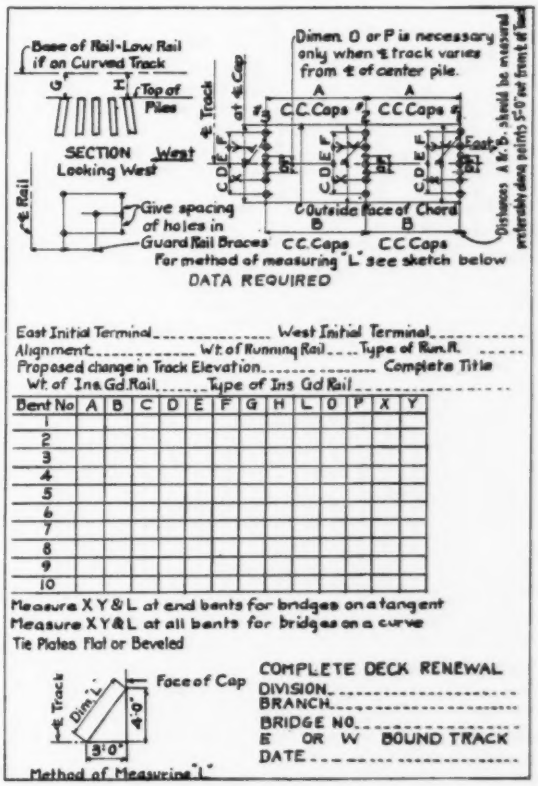
Form for Recording Dimensions for Preframing the Deck of a Deck Girder Span


Face of Backwall or ℄ of Floor Beam of Next Span
F D C B A
℄ Girder or Truss ℄
End of Bracket
℄ Of Stringers
WEST
EAST
℄ Track
℄ Of Floor Beams
Distance C. to C. of End Floor Beams = L
DATA REQUIRED
Fill in Dimensions
℄ of Rail
Show Spacing of Holes in Inner Guard Rail Brace
FLOOR BEAM STRINGER BRACKET
East Initial Terminal _____ West Initial Terminal _____
Alignment of Track _____ Weight & Type of Running Rail _____
Weight & Type of Inside Guard Rail _____
Size of ties on Span _____ Size of Ties on Backwall _____
Note: If Span is for Double Track Use 2 Sheets Marking One East Bound Track and other West Bound Track.
Note: Show dimensions X-Y-U & Z at all numbered points, that is on both backwalls and both sides of all Floor Beams and give elevations at these same points. Assume an Elev. of 10.00 for Top of Rail at Point 1 No. Rail
Tie Plates Flat or Beveled
COMPLETE TIE & GUARD TIMBER RENEWAL – T.P.G. & TRUSS SPANS
DIVISION _____ BRANCH _____
BRIDGE NO. _____ E OR W BOUND TRACK _____
SPAN NO. _____ (From E. end of bridge) DATE _____
SHEET NO. 1

Form for Dimensioning Deck on a Through Span—Table for Recording Dimensions Not Shown


C.C. Caps
Bent #3
Bent #2
Bent #1
West
East
℄ Track
Span #2
Span #1
C.C. Caps
Distances A, B, D & G should be measured preferably along points 5'-0" out from ℄ of Track
DATA REQUIRED
East Terminal _____ West Terminal _____
Alignment _____ Size of Ties _____
Complete Title _____ Size of Stringers _____
Bent No. Dim. L x Y C E F H Span No. D G
Run Rail Ins. G. Rail
Weight
Type
Spacing of Holes in Ins. Gd Rail Braces
℄ Rail
CS 33
CS 326
CS 328
Measure X Y & L at end bents for bridges on a tangent
Measure X Y & L at all bents for bridges on a curve
Tie Plates Flat or Beveled
COMPLETE TIE & GUARD TIMBER RENEWAL
OR COMPLETE STRINGER RENEWAL
DIVISION _____
BRANCH _____
BRIDGE NO. _____
DATE _____ E. W. BOUND TRACK.
℄ Track
Dim. L
4'-0"
3'-0"
Face of Cap
Method of measuring "L"

Form for Dimensions for Preframing Ties and Guard Timbers on a Trestle


Base of Rail-Low Rail if on Curved Track
Dimen. O or P is necessary only when ℄ track varies from ℄ of center pile.
Top of Piles
℄ Track
C.C. Caps
SECTION Looking West
East
℄ Rail
Give spacing of holes in Guard Rail Braces
Outside Face of Chord
Distances A, B, C should be measured preferably along points 5'-0" out from ℄ of Track
For method of measuring "L" see sketch below
DATA REQUIRED
East Initial Terminal _____ West Initial Terminal _____
Alignment _____ Wt. of Running Rail _____ Type of Run. R. _____
Proposed change in Track Elevation _____ Complete Title
Wt. of Ins. Gd. Rail _____ Type of Ins. Gd Rail _____
Bent No. A B C D E F G H L O P X Y
Measure X Y & L at end bents for bridges on a tangent
Measure X Y & L at all bents for bridges on a curve
Tie Plates Flat or Beveled
℄ Track
Dim. L
4'-0"
3'-0"
Face of Cap
Method of Measuring "L"
COMPLETE DECK RENEWAL
DIVISION _____
BRANCH _____
BRIDGE NO. _____
E OR W BOUND TRACK
DATE _____

Form for Dimensions for Preframing the Complete Deck of a Trestle

ing, embodies the use of six-pile bents 14 ft. center to center, with 14-in. by 14-in. by 14-ft. caps; four 8-in. by 17-in. stringers to the chord, two panels long with staggered butt joints on alternate caps and spaced 2 in. by cast iron separators; 8-in. by 8-in. by 9-ft. ties, spaced 12 in. center to center; and 5-in. by 8-in. guard timbers with halved joints.

The caps are drift-bolted to the piles and the chords are secured to the caps by means of 6-in. by 6-in. by ½-in. angles placed in a longitudinal position on top of the caps outside the chords, the vertical legs being punched near the ends to receive two chord bolts and the horizontal leg being slotted at the middle for a vertical bolt through the cap. This slot is provided to allow lateral adjustment in the position of the chords, but the position of the chord is fixed by means of an ingenious 12-sided washer, 5⅜ in. on the short diameter, that fits into the space between the vertical leg of the angle and small lug welded to the edge of the horizontal leg. By means of a choice of three holes punched in the washer at three different distances from the center and a selection from the 12 sides of the washer that may be in contact with the vertical leg of the angle, it is possible to vary the lateral position of the chord by 3½ in. in 20 approximately equal increments.

With this plan it is readily possible to prebore the trestle material for all holes except those in the piles, and the holes in the ties for the deck anchors. However, any holes that must be drilled in the field are treated with preservatives before introducing the bolts.

All trestles constructed on main lines are provided with a fire deck consisting of 20-gage galvanized iron that covers the deck from the top of one guard timber to the top of the other. On branch lines, the use of the protection is confined to a covering over the stringer chords and the caps.

The bridge gans engaged in maintenance work normally consist of a foreman and eight men. These gangs include two first-class carpenters, four second-class carpenters and two carpenter helpers. The size of the gang for trestle renewals depends on the length of the structure or the magnitude of the project. Concrete repair work and replacements of a character that would not be done by contractors is handled by construction gangs that are organized as required. The consist of the gang depends entirely on the character of the work to be done, and as a rule laborers as required are hired locally. The maintenance and repair of steel bridges, and such steel erection as is not done under contract, are carried on by floating gangs, of which three are normally employed on the Eastern district, while one does the work on the Central, Northwestern and Southwestern districts.

The practice of preframing has largely obviated the need for power equipment in handling timber work in the field except for the necessary use of pile drivers and the effective employment of power cranes in certain operations. Each division is assigned one driver, but if a second one is required an extra pile driver and crew are provided, and in the construction of long trestles arrangements are made to provide a bridge derrick car or a locomotive crane to unload material at the bridge site. In the case of shorter structures, the material cars are set out at the nearest siding pending the arrival of the bridge gang, when a work train is ordered to move the cars to the bridge site for unloading. On minor repair work the bridge gang is generally able to carry the necessary material on a car that accompanies the outfit.

While the scheduling of the work of the gangs is carried out in detail and is followed up consistently through the agency of monthly completion reports prepared by the division engineer, the plan does not embody a rigid subdivision of work as between various types of gangs. Instead, the schedules are prepared with view to meeting the particular conditions imposed on the various divisions. For example, if the trestle work on a division involves a heavy pile-driving program, the schedule will specify that the pile driver outfits are to do only the driving, and that the bracing, capping and deck renewal are to be done by follow up gangs. On the other hand, if there is not enough work to require the full time of the driver throughout the season, the schedule may provide for the completion of the work on each bridge by the pile-driver crew.

The practices of the Union Pacific described above are the result of a progressive development. The programming of bridge work was adopted about 10 years ago, while about five years ago the procedure was elaborated to embrace the complete scheduling of the work of individual gangs. Preframing had its inception about a year later and is now applied in all cases in the renewal of complete decks on steel bridges, in the renewal of entire decks or of all ties on wood trestles and in the replacement of trestles.

Success in such innovations entails a thorough instruction of the men and especially of the foremen in the details of the new procedure and particularly in the objective of the change, but in the case of the Union Pacific, the scheduling plan was adopted and thoroughly organized before preframing was introduced. This latter practice involves a rather drastic recasting of long-established ideas in the handling of timber, but once the men realized that structures could be erected without need for cutting the wood in the field, they became as enthusiastic for it as the officers.

Scrap Rail Piles

(Continued from page 790)

a point one foot from the end so that the end face of the pile consists only of the three heads. These piles have been made in lengths up to the full length of the rails, and in cases where greater lengths are required, followers of the same construction are attached by applying a pair of standard joint bars to each of the three rails. After the piles are driven, old tie plates or pieces cut out from old frog plates are welded to the top to provide adequate bearing area for the footing concrete.

The following is a summary of the out of pocket cost of 56 piles 16 ft. 6 in. long made of 100-lb. scrap rails:

Material:		
Welding rods	$186.32	
Acetylene	12.95	
Oxygen	8.45	
		$207.72
Labor:		
Foreman	$ 81.40	
Welding time	192.88	
Cutting time	39.76	
Assembling time	88.13	
		402.17
Total outlay 924 ft. of piles		$609.89
Cost per foot		$ 0.66

Owing to the heavy concentration of the metal in these piles near the center of the section, they are not as stiff per pound of metal as the commercial H-section steel piles. For example, the least moment of inertia of a pile composed of three 100-lb. rails, that is, one weighing 100 lb. per foot, is equal approximately to that of an H-section pile weighing 73 lb. per foot, the cost of which would be about $1.50. Thus, the scrap rail piles show an appreciable saving in cash outlay. However, if the scrap value of the rails, about 65 cents, and the cost of the welding current and incidental items are taken into account it will be found that the total cost of the scrap rail piles was approximately the same as that of standard steel piles.

Use of Off-Track Power Units

To what extent is it practicable to use off-track power equipment in the construction and maintenance of bridges?

Is Often Advantageous

By C. C. Westfall
Engineer of Bridges, Illinois Central, Chicago

When constructing bridges on a new alinement, it is practicable and ordinarily desirable to provide off-track power units for all of the work. When building long timber trestles on offset lines, we have used creeper drivers for driving the pile bents, air hoists for handling the timbers, crawler-mounted cranes for placing stringers and other deck timbers, and crawler tractors for distributing piles and timbers, as well as numerous smaller units of equipment.

In concrete work it is both practicable and economical to equip the jobs fully with off-track machines. For land work, crawler cranes are highly flexible, for which reason they are adapted for excavating, for driving foundation piles and sheet piling, and for handling aggregates and concrete. If cranes are not available, creeper pile drivers can be rigged up cheaply and used for the pile driving.

In the erection of steel viaducts on offset lines we have found that crawler cranes with long booms can be used to advantage in the erection of the viaduct towers ahead of the placing of the girders. A gin pole and a hoisting engine have also been used to advantage on work of this character. Stiff-leg and guyed derricks probably do not come under the classification intended in the question, but they will continue to be regarded with favor for many classes of bridge construction. Where substructure work must be done in streams or bodies of water where floating equipment can be used, this type of off-track equipment can entirely supplant on-track equipment if it is available and the size of the job will justify its use.

In contrast with a relatively wide use of off-track power units in the types of work already mentioned, we have made very little use of such equipment in the routine maintenance of timber bridges or in steel erection, where such work must be done without interruption to traffic. Yet our experience in construction indicates that where the ground conditions are favorable, crawler cranes can be used to advantage in conjunction with track drivers. We have also found that the simpler and original form of off-track equipment, that is, a team and wagon, can still be used economically and to good purpose around timber bridge work for the distribution of materials, where it is necessary to unload them at one end of the job.

It is scarcely open to question that, where ground conditions are favorable, practically every operation in bridge construction and maintenance, except steel erection and the driving of piles in existing trestles, can be handled satisfactorily and economically with off-track power equipment. The use of such equipment will eliminate one of the larger elements of cost in bridge work—work-train expense—and the delays to the work which always occur by reason of getting the work train out of the way of revenue trains. It appears doubtful, however, whether such equipment will come into general use for such purposes, for bridge maintenance is ordinarily so varied in character and the conditions at the site of so many bridges are unfavorable for the use of such equipment that the owning of expensive off-track equip-

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in February

1. In what ways may treated ties be damaged before they are inserted in the track? What can be done to overcome this abuse?

2. How far above the ground is it good practice to allow pile bents to project before applying sway bracing? Longitudinal bracing? What considerations other than height affect this? Why?

3. How does one determine wether a frog or crossing should be built up or repaired? Are we going too far today in rebuilding frogs and crossings? Why?

4. Should foundation walls for frame buildings be finished flush with the underside of the floor joists or be carried up around them to the floor level? Why?

5. When a soft roadbed on a heavy traffic line is ballasted with 8 or 10 in. of cementing gravel, is it better to continue its use when the track is resurfaced, or to apply stone ballast? Why?

6. Does the softening of water for locomotive-boiler use render it unfit for drinking? Why? If so, can the softened water be made fit for drinking?

7. What methods can be employed to reduce work-train expense without holding cars out of revenue service unduly?

8. What characteristics are fundamental in a paint for protecting steel surfaces?

ment for this purpose alone cannot be justified, although if otherwise available, it can often be used to advantage.

Every Job Individual

By P. G. Lang, Jr.
Engineer of Bridges, Baltimore & Ohio, Baltimore, Md.

First, let us examine the question. The main point is the distinction drawn between equipment that operates from the rails, for which reason it cannot be used except when on the track, and equipment which does not need a railway track for its support and is, therefore, free to move about on ordinary ground surfaces, and which may be mounted on plain wheels, rubber tires or provided with its own footing or track.

The next point is that the question relates to practicability and nothing is said about the economics of the use of the equipment. In this connection, it seems that economics is not directly involved as power equipment is under consideration and, essentially, up-to-date power equipment is quite likely to give economic results when used on types of work for which it is adapted.

This question, like many others, seems to be but a revival of a very old one. Certainly, some years ago, say, 40 or more, practically all work was done by hand, and where any equipment other than cars and locomotives was employed, it was of the off-track variety. Large and cumbersome timber travelers were built for erection purposes; gallows frames, gin poles and guyed and stiff-leg derricks were used; and hand winches were used for rolling and sliding operations. Many of these devices were operated by steam from stationary boilers, which actuated engines driving drums, to which lines were attached to provide the necessary movement, all of them coming under the category of off-track equipment.

In this sense it seems that there is nothing new in the question. On the other hand, since then derrick cars and locomotive cranes operating on the track have come into common use. Such equipment is used readily for lifting and placing heavy members in construction. Of course, such on-track power equipment has its uses, depending to a considerable extent, however, on the density and character of traffic and for what intervals the track or tracks can be occupied.

Certainly, many varieties of off-track equipment which can be manoeuvred readily and have considerable capacity, are now on the market. Depending on the availability of the desired units and the cost of moving them to and from the work, it seems clear that in many cases, as a practical and economic matter, off-track equipment can be used in the construction and maintenance of bridges. Every job, whether it be maintenance or construction, has its individual peculiarities and should, therefore, be studied in its relation to the programming of the work to be undertaken, and also to the forces which will be assigned to do the work. In addition to the individual characteristics of every job, one must consider the kind of equipment available and whether the work will be done by company forces or by contract.

Equipment for Fighting Snow

What special equipment and supplies should be supplied to the section forces for fighting snow? What disposition should be made of them when winter ends?

Must Be Well Equipped

By Bernard Blum
Chief Engineer, Northern Pacific, St. Paul, Minn.

Naturally, the amount and type of equipment which should be provided will depend upon the snow conditions. On lines where the winters are not severe or the snowfall is light, the requirements will not be as great as in an area where the winters are long and severe or the snowfall is normally heavy. In the northwestern states it is essential that the section forces be supplied with sufficient tools to take care of the normal snowfall, but it is not necessary or economical to equip every section with tools and supplies for an extraordinary blizzard, since it is feasible to meet such unusual weather conditions by special shipments from the stores.

Normally, every section is provided with an adequate supply of steel shovels, depending on the character of the particular territory, the number of depots, yards, sidings, switches, etc., which must be kept clear of snow. Old, nearly worn-out brooms should be saved and one should be set up at every main-line siding switch, where it will be readily available for trainmen for sweeping out switch points.

Experience will determine the number of shovels and brooms that should be on hand at the beginning of the season for the various sections. Around terminals, especially engine terminals, where water tends to accumulate and freeze, and thus become troublesome, the use of pneumatic hammers with specially pointed tools will be found to be most valuable. Those with hose of reasonable lengths can be attached to the permanent air lines in the vicinity, or connected with standard air-brake attachments to switch engines for breaking up ice accumulations rapidly and economically. Around interlockings the usual type of kerosene-burning torches have proved useful. At the close of the season it is advisable to collect, with supply trains or other suitable means, the snow-fighting tools and send them to the storehouse and reclamation plant for repair and storage until they are again required.

In general, the most effective snow removal is done with snow plows, bulldozers, etc., and economy dictates that the efforts on the individual sections should be confined to supplementing the work of this equipment with those activities which can best be done by hand. The use of horse-drawn snow plows and crawler-mounted tractors with suitable snow pushers in connection with the section forces, has also been found to be most valuable.

Conditions Differ

By Division Engineer

In considering the types and amount of equipment and supplies to be provided for the section forces for fighting snow, one must differentiate between the conditions normally encountered on the various sections;—in other words, between severe and relatively mild conditions of snow and temperature; between lines of heavy and light traffic; and between sections having few switches and those having many, as well as those having interlockings and those having none.

A section having only one or two infrequently used switches and a small station platform may need only its ordinary complement of shovels and picks and a few brooms. One broom should be placed on a post near each switch for the trainmen's use when necessary to use the turnout. A section having interlockings or a large number of switches which are used frequently should be provided with switch heaters, a number of which are on the market, for keep-

ing the switches open. The day is past when full reliance can be placed on hand labor to keep switches clear during a severe or long-continued snow storm. Switch heaters have been known to pay for themselves in a single storm in the reduced cost of labor, to say nothing of the savings which accrue through elimination of delays to trains and switching crews.

With the heavy snow-fighting equipment now available, such as snow plows, flangers, spreaders, bulldozers, cranes, clamshells, draglines, etc., it is folly to expect the section forces to attempt to handle bulk snow. Their efforts should be confined to clearing switches, grade crossings, platforms, driveways, etc. A tractor with a push plow or rotary broom can often do more than 100 men in keeping driveways open, and usually do it better. If the snow must be loaded out, a loading device will add further to the economy of the equipment. In not a few cases, a tractor with a plow or broom can also be used to advantage in clearing large station platforms.

These are only a few suggestions arising out of the question. Others include snow-melting can, torches, snow-melting salts, common salt, provision for steam, snow melting pits and other devices and supplies. Because of the varied conditions under which snow fighting must be done, no general statement can be made as to the special equipment and supplies which should be provided for all cases. Maintenance officers know from experience what can be expected normally on each section and from the wide variety of devices now available should be able to select those best adapted for these conditions.

Welding in the Track or Shop?

What are the relative advantages and disadvantages of building up frogs by welding in the track and of sending them to the shop to be reconditioned? What additional life can be expected from a built-up frog?

Reduces Cost

By Charles Wise
Welder, Proviso Yard, Chicago & North Western, Bellwood, Ill.

Primarily, the advantage of welding frogs in the track is that it eliminates the cost of handling, although many trackmen add that the life of the switch ties is definitely conserved by the practice. This latter advantage may be lost, however, by the fact that the ties are often burned under the frog during the process of welding. The advantage of avoiding the cost of handling may be lost if too many interruptions occur by reason of switching or the movement of other trains. Welding always costs more where the welder must constantly be on the lookout for trains, since this slows up his work. Likewise, on a busy ladder track, switching is slowed down by the fact that the switching crews must look out for the welder.

About the only disadvantages of sending frogs to the shop are the cost of handling and the larger stock of frogs that must be maintained. A welder can do much better work in the shop where there are no trains to run over his unfinished work, while the cost of the welding is less, and there is no loss of time because of weather. Frogs with broken points or wing rails can be repaired in the shop.

Most welded frogs have a longer life than when new, and they can be built up time and time again until they are unfit for service for other reasons. I have built up frogs as many as five times before it was necessary to discard them. Ordinarily, a main-track frog cannot be reconditioned as often as one in a yard.

As Good As New

By C. R. Edwards
Supervisor Welding and Work Equipment, Wabash, Decatur, Ill.

Among the advantages of building up frogs in the track are: (1) a smaller stock of replacement frogs is required; (2) the cost of handling and shipping is eliminated; (3) their life is extended because connecting members are ground to surface, thus reducing impact; and (4) there is less distortion and, therefore, less likelihood of cracking because of unrelieved internal strains.

Among the disadvantages of welding frogs in the track are: (1) it is more difficult to control the temperature when welding in the field; (2) frequent interruption by trains before the welding is completed may result in inferior welds; (3) considerable time may be lost by the welders because of train interruptions; and (4) time is lost by the welders in moving equipment. Except for frogs in busy tracks or those at remote points, however, re-conditioning in the field will probably be more economical.

A properly rebuilt frog should have as long a life as a new one because the places subject to the most wear can be made more resistant to wear and impact because of better surface alinement with its members, at the same time reducing impact.

Two New Frogs in 10 Years

By J. P. Corcoran
Supervisor, Alton, Bloomington, Ill.

I have been welding frogs for 11 years, including both main and yard tracks. All of our main-line frogs are spring frogs and when we weld them we repair them thoroughly, tightening all bolts and cutting out and replacing loose rivets. When welding the wing rail we spike it at the end to prevent warping. As a regular practice we go over all of these frogs every two years. During the period since 1925, I have found it necessary to order only two new frogs, except where we have laid new rail, and these were to replace broken frogs. A careful record indicates that the average cost for a complete job of welding and overhauling is about $11, including the necessary section labor.

We also rebuild our yard frogs in the track. A particular advantage here is that it is not necessary to change rails to fit the full section of a new frog. The cost in this case is about $15, because we provide two flagmen to protect the welder, and there are usually so many interruptions that the labor charge runs higher. Including the cost of handling to and from the shop and the cost of changing rails to fit the replacement frogs, I estimate that we save about $22 by welding in the track.

Favors Welding in Track

By C. E. Morgan
Superintendent of Work Equipment and Welding, Chicago, Milwaukee, St. Paul & Pacific, Chicago

The principal advantage of building up frogs while in the track, as compared with removing them to the shop, is that less help is required to do the work, while a smaller stock of frogs will be necessary for a given yard or division. If the work is done in the shop a larger reserve supply must be maintained for both storage and transit. The handling charge for removing and shipping and for plac-

ing the substitute frog, as well as of the return shipment and replacement, may be greater than the actual cost of welding the frog in the track, unless traffic is exceptionally dense, so that the welder gets but little working time.

Interference with switching crews in yards is about the same in either case. If a switching crew is willing to co-operate with the welders on a busy lead, however, a frog can be built up and cars can be allowed to pass over the frog at any time during the progress of the welding. If the frog must be taken out, the lead, or part of it, will be tied up while this is being done.

One of the disadvantages of welding frogs in the track is that welders are not always available when the work should be done. The first few frogs in a busy ladder will require attention before most of the others in the yard. By having a few spare frogs on hand, the worn frogs can be changed out quickly and held for a floating welding gang. This probably offers the best solution of this problem, since it becomes unnecessary to move the worn frogs very far.

Out on the line, rail-end welding crews can care for the frogs as they encounter them in their out-of-face work. In terminals, however, where many frogs are involved, special crews are of advantage, since the concentration of the work tends to hold the reclamation cost to a low figure.

The life of a frog can be prolonged by welding until the wear on the rail head and shallow flangeways renders it unfit for further service. Frog-point and wing-rail wear do not of themselves determine the life of a frog today. Even in remote places where worn frogs may be removed, they can be built up and returned to service. We have found frogs in service at some points on our line that are known to have been welded as many as six times. I expect to see marked advances in the art of reclaiming frogs by welding in the next five years.

Advantages All One Way

By J. Morgan

Supervisor, Central of Georgia, Leeds, Ala.

All of the advantages are in favor of building up frogs in the track. By this I mean that a good job can be done and the cost of removing and replacing the frogs is avoided. When to this expense is added the cost of shipping and handling at the shop and of reshipment to the same or another point of use, it becomes quite a respectable item. We invariably build up our frogs in the track before they have worn badly, because if they are allowed to run too long the cost is relatively much higher and their life may be shortened by the abuse they have received.

It is difficult to say how much additional life can be expected from a built-up frog. We find that where the work is done properly the frog will last as long as the rail from which it is made. In numerous cases I have kept frogs in service in main tracks, keeping the worn parts built up, and finally removed them because the rail was worn to the point where it was no longer serviceable, or the frog needed other extensive repairs.

Storm Windows on Stations

To what extent is it practical to equip small and medium-sized stations with weather strips and storm windows?

Insulation Pays

By General Inspector of Buildings

There are many places where storm windows will increase the comfort of buildings and save fuel in heating them. Conversely, there are many others where the expense of placing storm windows may be entirely wasted unless other work is done which will prevent leakage of the heat from the interior of the buildings. Not a few cases occur where the leakage through window and door frames accounts for a considerable part of the heat losses, sometimes far more than occur through the window area. Obviously, unless these leaks are stopped, little benefit will be obtained from the application of storm windows.

Again, it must not be overlooked that many of the small and medium-sized stations on any railway have been designed to be built at minimum cost. The result of this policy is that few of them, except perhaps in the more rigorous climate of the far northern sections where extremely low winter temperatures are common, are weather tight. That is, little provision other than the use of building paper, has been made to prevent heat losses through walls, floor and roof. For this reason, the heat losses through the window area are only a small part of the total, so that the application of storm windows may make little difference in the amount of fuel consumed or the comfort of the occupants.

These facts should be considered carefully when deciding whether to apply storm windows. If the building is weather tight it is quite likely that storm windows can be justified. If it is not weather tight, the cost of applying and maintaining them may be just so much waste. It might be pertinent to observe at this point that I have come to believe that no road can afford to erect a building which must be heated, without including adequate thermal insulation in the construction. Likewise, when an old building requires major repairs, I am convinced that it will pay to apply such insulation.

Insulation adds only a small percentage to the original cost of the structure, although, relatively, the cost to apply it to an old building will be somewhat greater. It must not be overlooked, however, that this expense is incurred but once, while the cost of fuel for heating is a continuing expense. It has been demonstrated over and over again that the cost of heating buildings can be reduced by 25 to 40 per cent through the use of adequate and properly applied thermal insulation. It is clear, therefore, that whatever additional expense will be required to apply it, will be repaid in a short time and that the savings which accrue thereafter will be on the profit side of the ledger.

I am not in favor of putting weather strips on small and moderate-size stations. There are too many opportunities for them to be damaged and the maintenance expense is all out of proportion to the benefits.

May Be Economical

By Engineer of Buildings

This is a question which we have considered at various times and while we have not adopted the practice of equipping all stations with storm windows, we have applied them to numerous buildings of various types. We have not as yet applied weather strips to stations, although some of our offices have them, and here their use can be easily justified.

While the comfort of the occupants of the buildings cannot be ignored, the important consideration is the economy which will be demonstrated by the application of storm windows. In

many cases there is no question but that the saving in fuel will repay their cost in a relatively short time. In other cases the savings are not so apparent, for which reason we have been somewhat cautious about making it a general practice to fit storm windows to all buildings.

At many of our smaller stations the passenger business has fallen off so much in recent years that we have been reluctant to spend money on improving the facilities, particularly in view of the difficulty we have experienced in obtaining the appropriations necessary to keep the structures from actual deterioration. We have, in a considerable number of cases, however, fitted the office section of these buildings with storm windows, thus adding to the comfort of the agents and operators and at the same time saving some fuel. We have found that, as a rule, it is of greater advantage to equip office buildings, where there is a larger number of employees, with storm windows than it is to do this for small stations, particularly where the waiting rooms are little used. As the importance and size of the stations increase the advantage of providing storm windows also increases, and we believe that every case should be given serious study with the view of providing them if they can be justified.

Four-Bolt vs. Six-Bolt Joints

Is a four-bolt or a six-bolt joint more effective as a rail fastening? Why? If the latter, is its advantage sufficient to justify its additional cost?

Long Joint Rides Best

By William Michel
Chief Engineer, Engineering Advisory Committee, Chesapeake & Ohio, Cleveland, Ohio

It is my observation that the supported type of joint produces the best-riding track. This of necessity requires the use of six bolts and a long bar reaching over three ties. I am sure that all engineers who have had experience with supported joints will agree with this. On the other hand, on roads with very light traffic, a short bar with four bolts may be more desirable, since the cost of the short bar is less than that of the long one.

Depends on Rail Section

By Armstrong Chinn
Chief Engineer, Alton, Chicago

This is a difficult question, which has been in controversy for many years, and at present there seems to be no prospect that it can be given a definite answer. Four-bolt joints are used on some roads and six-bolt joints on others, apparently with equal success. The four-bolt joint is usually of the suspended type, supported on two ties, while the six-bolt joint is ordinarily carried on three ties, with the middle tie directly under the rail ends, and is termed a supported joint. Because of the additional bolts, the six-bolt joint offers more resistance to the pulling apart of the rails in sections subject to extreme cold. On the other hand, the extra bolts and extra length of the joint bars result in greater clamping action on the rail, thus increasing the probability that the joint will "freeze" to the rail, stopping expansion as the temperature rises and causing kinky rail during hot weather.

An ideal joint would be one that would permit the rails to expand and contract freely, and at the same time would be capable of carrying the wave action of the rails, under rolling loads, through the joints the same as through the body of the rails. If this ideal could be attained, there would be no need of any special tie spacing under the joints, since the ties could be spaced uniformly without reference to the joints.

Since a properly designed joint should have the same wave action, or flexure, as the rail, its length should be proportional to its height, so that its beam action would be about the same as that of the rail. In other words, its length should be governed by the height, and therefore by the weight of the rail. Obviously, a 36-in. joint bar is unnecessary on a 60-lb. rail, while a 24-in. bar on a 131-lb. rail would be so short and stiff that four bolts could scarcely hold it in place for proper flexure. For these reasons, four-bolt joints will probably be entirely satisfactory on rail weighing 100-lb. or less, while heavier rails, because of their greater height, will do better with six-bolt joints.

Favors Six-Bolt Joints

By J. V. Neubert
Chief Engineer Maintenance of Way, New York Central Lines, New York

Our experience with the two types of joints mentioned in the question leads to the belief that the six-bolt joint makes a better rail fastening than the four-bolt type. It gives better support to the rail ends, both vertically and horizontally, while this joint is also better supported by the ties. It is our experience that the additional expense for this joint can be fully justified.

Fire Hydrants at Enginehouses

What considerations should govern the location of fire hydrants around enginehouses and shops? What other forms of fire protection should be provided?

Independent Fire Lines

By W. A. Radspinner
Superintendent Fire Prevention, Chesapeake & Ohio, Richmond, Va.

Fire hydrants should be not less than 6 in. in size and should have steamer connections. They should be on a separate system which is kept free of all service connections, and the fire lines should loop and grid the property. If the fire pumps are electrically driven, the power should be obtained from two or more independent sources, and at least one standby pump should be driven by an internal-combustion engine.

Fire-fighting equipment must be in shape for instant use. A hose house with 250 ft. of hose attached to the hydrant and properly coiled in the house will save much time in getting water on a fire. There should also be several coils and extra nozzles for a second fire stream or to permit an extension of the first hose. Other equipment in the hose house should include spanner wrenches, hose washers (gaskets) and a fire axe.

Other forms of protection include hose carts, to supplement the fixed hose stations, a complete fire-alarm system, an automatic coded siren, fire lanes through shops and over tracks which must be kept open at all times

and a complete equipment of first-aid fire extinguishers. Many other special items are desirable for large shops, such as hourly watch service, sprinkler systems, etc., where special hazards exist.

Not Nearer Than 50 Ft.

By G. R. Hurd
Superintendent Fire Protection, Illinois Central, Chicago

Experience has shown that in locating fire hydrants around enginehouses and shops they will serve most effectively and economically if (1) fire lines are not less than 6 in. in diameter; (2) two-way fire hydrants are located approximately 300 ft. apart, but not nearer than 50 ft. to any building; and (3) the fire system is provided with Underwriters fire pumps of not less capacity than 1,000 gal. per min., which is sufficient to accommodate four streams. A sufficient amount of double-jacket fire hose with nozzles, together with spanner wrenches, gaskets, etc., should be kept on hand. Reels should be provided, each containing at least 250 ft. of hose. All buildings should be provided with substantial fire ladders to give ready access to the roofs.

Threads on the fire hydrants should conform to those in the nearby city or village, where city protection is available. This is an important feature, since assistance from these nearby fire companies may be needed badly. The threads on the washout lines in enginehouses should be the same as those on the fire hydrants, so that they can be employed in an emergency.

Where oil-burning locomotives are housed, foam extinguishers or tubs of sand should be provided. The same form of protection should be placed at outlets for filling oil-burning firing-up equipment, particularly if the locomotive-washing equipment is installed inside the enginehouse. Electric wires to the turntable should be run underground or in some other manner which will avoid the necessity of supporting them on any part of the enginehouse, or of passing them over the structure, since a fire in the building might damage them and thus make the turntable inoperative.

Other shop buildings should be provided with fire extinguishers of the soda-and-acid type for free-burning fires. Electric hazards call for either the carbon-tetrachloride or the carbon-dioxide type of extinguishers, while either of these types or the foam extinguishers are adapted for oil fires. Finally, well-organized and well-drilled fire brigades are most essential for fighting fire. In shops where more than one shift is worked, each shift should have its own brigade.

Why Is Rail Branded?

What is the significance of the several branding marks on rail? What importance should be attached to each?

Tell a Definite Story

By J. R. Mooney
Assistant Manager, Rail and Fastenings Department, R. W. Hunt Company, Chicago

Rails are branded to show (1) the weight and section number (11025), (2) the type (R. E.), (3) the kind of steel (OH), (4) the manufacturer and mill (Inland), (5) the year rolled (1936) and (6) the month rolled (111111). This brand is cut into the rolls and appears on one side of the web in raised figures. On the other side of the web certain figures and letters are stamped which indicate (1) the heat number (63345), the rail letter (D) and the ingot number (17).

Taken together, the branding and stamping completely identify every rail from every other rail, but either the brand or the stamping alone will not do so. The brand is self explanatory, but the meaning of the stamping is not so clear. In a steel mill every furnace is numbered and every heat which is turned out is also numbered. The heat number on the rail is a combination of the number of the furnace and of the individual heat. For example, in the foregoing illustration, 63345 represents heat number 345 from furnace 63. Likewise 816021 represents heat number 6021 from furnace 81. The numbers assigned to heats generally start with 001 every year. This fact is of special significance, because the year and month of rolling must be recorded to permit complete identification of the heat.

A heat of steel is poured into molds to make the ingots from which the rails are rolled, 20 to 25 ingots usually being obtained from a heat, although there may sometimes be as many as 35. The ingots are numbered either in the order in which they are cast or rolled, and this is the number indicated by the stamping. An ingot will make several rails, the one obtained from the top being designated as A, the next B and so on to the last one rolled from the lowest part of the ingot.

Rail older than 12 to 15 years are not branded and stamped in this manner, since only the heat number is shown and there was not always uniformity in the branding. In the brand, some roads prefer to indicate the month by numerals rather than by a series of vertical lines.

Sometimes Puzzling

By District Engineer

While there should be no confusion as to the meaning of the branding marks on rail, the information given by the stamped characters on the opposite side of the web are not so clear and may sometimes be quite puzzling to one not altogether familiar with the methods followed in rail manufacture. The first set of raised figures at the left of the brand, say 11225, indicates that the rail weighs 112 lb. and that the manufacturer's designation of the section is 25. Next come letters, say RE, which in this case identifies it as an A.R.E.A. design. This is also indicated by the section number given, for all rails of A.R.E.A. design are numbered 25, regardless of their weight. The next letters, for example OH, indicate the kind of steel, this particular designation meaning open hearth. The manufacturer's name and mill is shown next, say Illinois U.S.A., which is the designation of the Gary plant of the Carnegie-Illinois Steel Corporation. Next follows the year and month rolled, 1936 11111, showing that the rail was rolled in May, 1936.

Every heat of steel is identified by a number. A heat may be only a few tons or as much as 150 tons, but every fact connected with the making of it is recorded carefully, including the chemical composition of the finished product and every step taken in its production. The heat number is, therefore, the index of the complete history of the manufacture of that particular heat, which may be re-

viewed if occasion ever requires. The heat numbers are stamped on the opposite side of the web from the brand.

Following the heat number is a letter which shows the position of the rail in the ingot and this in turn is followed by a number which indicates the particular ingot from which the rail was rolled. From this method of branding, a complete index is available for tracing the entire production story of any rail, since all of the records of manufacture and the rolling data are preserved at the producing mill. It is obvious that when reporting the failure of a rail it is important that all of the identifying marks in both the brand and stamping be given, for each one tells only part of the story of the manufacture of that rail.

Inspecting Structures

When inspecting masonry substructures, what items should be given particular attention? What is the importance of each?

Watch When Trains Pass

By A. R. Ketterson
Assistant Engineer of Bridges, Canadian Pacific, Montreal, Que.

One of the first items to be observed when inspecting bridge substructures is whether bed plates and rollers are clean and whether the latter are in proper position to move squarely back and forward with the expansion and contraction of the span. Any binding which prevents free movement may develop cracks in the bridge seat. In long spans these cracks may extend down through the shaft of the pier or through the abutment. Also examine the anchor bolts carefully.

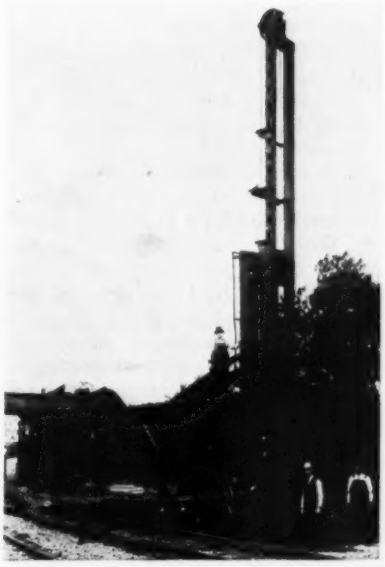
One should examine piers and abutments with respect to joints, loose stones, cracks and other defects. When such observations are compared with the records of previous inspections, they often indicate whether there has been any loosening of the unit as a whole in the interval since the last inspection. Note whether the masonry needs pointing and whether cracks have opened since the last pointing. Also make such measurements as are necessary to locate the cracks for future reference.

Bridge seats should be cleaned and well drained. If the structure is of stone masonry, note particularly the condition of the stone under the bearings of the span. If the structure was built with lime mortar, the joint material often becomes inert as it ages and is subject to vibration, so that the mortar under the bridge seat stones is milled and forced out as a result of the pounding it receives during the passage of live loads, thus permitting the stones to loosen and rock.

Examine closely the junction of wing walls with the body of the abutment to ascertain whether cracks are developing, which indicate settlement or relative movement between the wings and the abutment. Likewise, one should inspect closely for cracks, open joints or broken stones on the nose of cutwaters of piers. Where masonry piers are not protected by steel nosing plates, the cutwaters should be examined for disintegrated mortar joints and loose stones. Cutwater joints should be well pointed, otherwise the erosion of the mortar joints will continue into the interior of the pier, at which stage repairs become expensive. Note particularly the condition of bolts or other devices which anchor steel nosing plates to the cutwater.

In many instances it will be advisable to take soundings to ascertain whether there has been any change in the stream bed since the last inspection and whether there is sufficient overlying material above the footing course to prevent undermining of the footing. Where there is a tendency to scour, the substructure should be protected by riprap, the condition of which should be examined at each inspection. If the water is deep, and especially if the flow is rapid or if the unit is located at a bend in the stream, a periodic under-water inspection should be made by a diver. Also note whether debris has collected at the upstream end of the abutments or around the cutwater of the piers; such accumulations are likely to cause scour.

Even though there may be no visible indications of defects in the portion of the substructure above the ground or water line, one should never consider the inspection of the substructure complete until its behavior under the passage of trains has been observed.



An Essential Item of Bridge Equipment

Few, But Vital

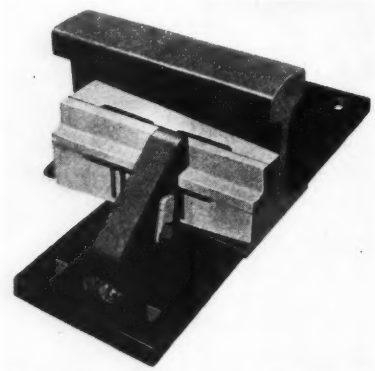
By John L. Vogel
Bridge Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

While the items which should be given particular attention when inspecting masonry substructures are few in number, they are of vital consequence. When inspecting stone masonry we must first look for cracked stones, which is an indication that they are being or have been subjected to undue stress, almost invariably as a result of uneven settlement of the foundation. While improper placing of the stones may result in similar cracks, failures from this cause occur less often than those from settlement. Loose pointing is an indication of settlement, of a veneer facing with loose backing or filling or of improper design. The tipping of abutments or piers may not result in cracks or loose pointing but is evidence of either settlement or shoving. It should be checked carefully as to extent and direction.

In the case of concrete masonry, we must look for spalling or disintegrated material which is evidence of poor material, poor workmanship, improper drainage or inadequate bearing area for shoes or pedestals. Again, one should be particularly attentive to cracks, the character of which indicates that they are due to settlement of the foundation, or to other causes such as temperature changes, inadequate provision for drainage, or to eccentric loading from bearings (superstructure) as a result of faulty design. Where settlement or other movement is indicated by the conditions observed, it is obviously important that a check be made of the profile and alinement to determine the direction and extent of the movement that has taken place and its probable causes.

Spring Rail Brace

A NEW ADJUSTABLE spring rail brace has been developed by the Bethlehem Steel Company, which provides resiliency for full recovery from side thrusts of the rail, and at the same time, maintains constant pressure on the rail, preventing track vibrations from loosening the wedging member. The new brace, which conforms to



The New Bethlehem Spring Rail Brace Assembled on a Section of Rail.

A.R.E.A. requirements in that its wedge bears against both the web and base of the rail, consists of two parts; a combined rolled steel switch place and brace, and a specially shaped wedge block, to which is welded a heavy angular spring-steel piece, to form the wedge as a whole.

The bracing member is integral with the switch plate, being heavily welded into a machined slot in the plate. The face of the bracing member, which is machined to make a close fit with the wedge, has a horizontal slope of 1 in 16, and a vertical slope of 1 in 8, corresponding with slopes on the wedge. The angular spring-steel piece of the wedge, which is interposed between the bracing member and the main block of the wedge, provides the resilience in the brace, it being claimed that the spring piece will withstand a compressive force of at least 12,000 lb, before it is brought to a close against the stop provided.

As applied, the wedge is driven into position until the spring is compressed approximately 1/32 in. This sets up a heavy pressure on the base and web of the rail, which practically assures against the wedge becoming loose in service. However, as an additional factor of safety against backing out of the wedge, a pawl is attached to the brace, which is designed to be lowered into any one of a series of slots on the back of the wedge block. These slots permit of an adjustment of 1/16 in. No tools other than a spike maul or a hammer are required to install or adjust this new adjustable rail brace.

Some New Protective Coatings

FOLLOWING several years of research and large-scale tests in the field and in the laboratory under widely varying conditions, Technical Coatings, Inc., New York City, has developed and is offering to the railways a complete line of protective coatings for metal, wood and concrete surfaces. These coatings, which have already been applied to many railway and other structures for periods of 12 to 20 months, are said to produce a tough, elastic, non-porous surface, designed specifically to combat corrosion, deterioration and wear in their various forms.

The special feature of these coatings, specific types of which are adapted for bridge and building painting under a wide range of atmospheric conditions, including bridge decks subject to brine drip, is the vehicle employed, which is a specially processed combination of pure vegetable gums and heat-treated oils. Through the process of manufacture employed, it is claimed that the resulting vehicle is impervious to moisture and gases, and thus offers a protective film which will prevent corrosion or deterioration of the surface coated for a long period of time.

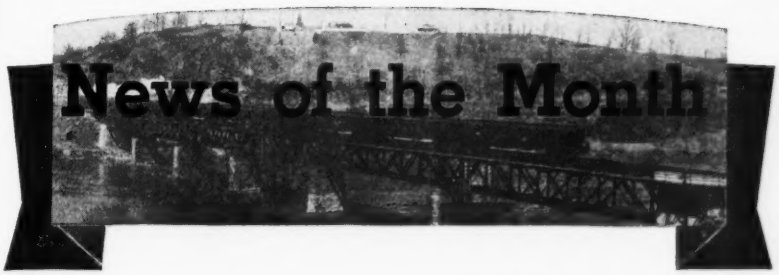
The various technical coatings are made with different types of metallic pigments in a considerable range of colors. The primers offered for various conditions of exposure include a zinc-metallic coating, an aluminum-zinc coating, and a balanced red lead coating, all of which employ the non-porous vehicle as a base. The top coatings are furnished regularly in gray, white, black, buff and green, or with an aluminum or sandstone color, and, on order, can be tinted to give other color effects.

Tests and experience show that the coatings, in addition to being impervious, adhere tenaciously and, being elastic, do not crack or peel with even severe expansion and contraction. All of the coatings can be applied by brush, spray or by dipping.

Claim Advantages for New Sheathing

A NEW type of sheathing material for application to the exteriors of all types of frame buildings, which is said to have great bracing strength and to be highly resistant to moisture absorption and air infiltration, has been developed by the Insulite Company, Minneapolis, Minn. This product, which is known as Bildrite sheathing, is made of wood pulp in much the same manner as Insulite insulation but is impregnated with a special asphalt emulsion during the manufacturing process, which is said to impart added strength and resistance to moisture. The new sheathing, which is 25/32 in. thick, is available in pieces having a standard width of 4 ft. and lengths up to 12 ft.

As a result of erection tests it is reported that, including the erection of the scaffolding, sawing, fitting, etc., 132 sq. ft. of the material can be erected per man-hour. Records compiled during a heating season in northern territory are said to have indicated that the use of this sheathing effected a saving in fuel amounting to about $10 per 1,000 sq. ft. of wall area (based on $13 per ton for coal and 7 cents per gallon for oil).



Prof. Talbot Awarded John Fritz Gold Medal

Arthur N. Talbot, professor emeritus of engineering at the University of Illinois, has been awarded the John Fritz Gold Medal, highest of American engineering honors. Prof. Talbot was cited as "moulder of men, eminent consultant on engineering projects, leader of research, and outstanding eduactor in civil engineering." This award is made annually for notable scientific or industrial achievement by a board composed of sixteen past-presidents of the four national societies of civil, mining and metallurgical, mechanical, and electrical engineers. Prof. Talbot is best known in the railroad field for his research in connection with stresses in track on behalf of the American Railway Engineering Association.

"Fan" Excursion Includes Lecture

While railroads, particularly those in the East, have been active in operating railroad "fan" excursions to points of interest in recent months, the first of such excursions to involve the use of a lecture as a means of entertaining the passengers was operated on the Central of New Jersey on November 8. On this excursion, which was operated over a 325-mile route, a representative of the railroad delivered a lecture, concerned principally with points of interest along the route, with the aid of a public announcer system with a loud speaker in each car. A microphone was set up in the baggage compartment of the combination baggage car and smoker at the front end of the train. This aparatus was placed on a table in the center of the car and between the two doors, which were left open to give the lecturer a view of both sides of the track. The lecture was so favorably received by the passengers, who numbered 121, that the railroad plans to develop the idea more fully next spring.

P.W.A. Makes Profit on Loans to Railroad

Through the sale of a portion of the bonds and securities accepted by it to cover loans of $200,529,000 to 32 railroads for rolling stock, motive power, modernization and other improvements, the Public Works Administration has realized a profit of $3,218,247, according to a special report made by the accounting division of the PWA. The report shows that these loans enabled the 32 railroads to construct and purchase three high-speed streamlined trains, 195 locomotives, 303 passenger cars, and 36 mail and express cars which went to make up a number of other well-known high speed trains, and 24,170 freight cars. The loans also were used to finance the repair and reconditioning of 1,928 locomotives, 947 passenger cars, 40,977 freight cars, and the equipment of 300 freight cars with automatic loaders. Considerable reconstruction of roadbeds, bridges, culverts, and other structures also was financed with PWA funds, including completion of the electrification of the Pennsylvania between New York and Washington.

Rail Orders Soar in November

During November the railroads of the United States placed orders for rail aggregating approximately 440,000 tons, thus giving this month the distinction of being the most active from the standpoint of the tonnage of rails ordered for many years. In fact, the tonnage of rails ordered during November exceeded the total tonnage of rails rolled during the entire year of 1932 by about 40,000 tons. The largest program to be announced was that of the Pennsylvania which purchased 100,000 tons of rails at a cost of approximately $4,000,000. Next in size was the order of the New York Central for 82,150 tons at a cost, including fastenings, of $5,500,000, while the third largest order was that of the Chicago & North Western for 48,500 tons. Other large orders included those of the Chesapeake & Ohio, for 37,471 tons, the Chicago, Rock Island & Pacific, for 35,000 tons and the Missouri Pacific, for 33,950 tons. In addition, the Union Pacific ordered 20,000 tons; the Nickel Plate, 13,536 tons; the Denver & Rio Grande Western, 12,640 tons; the Illinois Central, 10,000 tons; the Pere Marquette, 9,200 tons; the Kansas City Southern, 8,000 tons; the Texas & Pacific, 7,550 tons; the Nashville, Chattanooga & St. Louis, 6,075 tons; and the Long Island, 6,000 tons. The Atchison, Topeka & Santa Fe is inquiring for 90,000 tons and orders for this tonnage were expected to be announced momentarily at the time of going to press.

Late in November the steel companies announced that, as the result of a greater demand and increased costs resulting from higher wages to employees, the price of steel rails would be raised from $36.75 a ton to $39 a ton, effective December 1. Comparable increases were also made in the prices of other steel products. During the depression the price of rails was reduced from $40 a ton to $37.50 a ton in an effort to stimulate railroad buying. Later, at the instance of Joseph B. Eastman, then federal co-ordinator of transportation, the price was reduced to $36.375 a ton, which figure prevailed until the recent increase.

Railroads Net Higher in September

Class I railroads of the United States had a net railway operating income in September of $70,166,026, which was at the annual rate of return of 2.32 per cent on their property investment, as compared with a net of $57,349,265, or 1.9 per cent in September, 1935, according to reports compiled by the Bureau of Railway Economics of the Association of American Railroads. Operating revenues for September amounted to $357,206,662 as compared with $306,946,095 in September, 1935, an increase of 16.4 per cent. Operating expenses totalled $248,553,260 as against $218,071,436.

For the first nine months of 1936, these railroads had a net railway operating income of $434,864,004, or 2.3 per cent, as compared with a net of $321,201,769, or 1.7 per cent, for the first nine months of 1935. This was an increase of 35.4 per cent. Operating revenues for the first nine months of this year totalled $2,930,464,310, as compared with $2,511,779,127 for the same period in 1935. Operating expenses amounted to $2,164,601,812, as against $1,917,393,205.

Eastern Railroads Establish C & D Service

Pick-up and delivery service on l.c.l. freight went into effect on railroads in Eastern territory on November 16, in accordance with an order of the Interstate Commerce Commisison, made public on October 30, in which it found such service justified. The order requires the railroads to establish a rate of not less than 45 cents per 100 lb. on shipments accorded pick-up and delivery service and gave them permission to make an allowance of 5 cents per 100 lb. to consignees or consignors who make their own arrangements for pick-up and delivery. The commission had previously suspended tariffs applicable to pick-up and delivery service in eastern terirtory which were to become effective on April 1, 1936.

Approval of the new tariffs by the commission was opposed strenuously by trucking interests which, failing to convince the commission that the tariffs were unjustified, sought to obtain court injunctions restraining the railroads from placing the tariffs in effect. On November 14, the federal district court for the District of Columbia denied a petition of the American Trucking Association, Inc., for a preliminary restraining order and said it would rule within 10 days on the question of whether an interlocutory injunction would be granted. On the same date a court in New York, in denying an application of the Merchant Truckmen's Bureau of New York, said "the petitioner's right to a permanent injunction after a final hearing is much too doubtful to justify the granting of an interlocutory injunction."

Association News

Roadmasters Association

President B. E. Haley is planning to call a meeting of the executive committee in Chicago late in December to formulate plans for the year's work and to appoint committees to undertake the preparation of reports on the subjects recommended at the last convention and approved by the executive committee at its meeting immediately thereafter.

Bridge and Building Association

President E. C. Neville has called a meeting of the executive committee in Chicago at 10 o'clock on Saturday forenoon, Dec. 12, at which time the principal business will be the appointment of committees to study and prepare reports on the subjects selected for consideration in 1937.

Metropolitan Track Supervisors Club

The next meeting of the club will be held on December 10, at the Hotel McAlpin, New York City, on the same day at the annual dinner of the New York Railway Club. Following an informal luncheon at noon, at which I. H. Schram, engineer maintenance of way of the Eastern District of the Erie, will speak on New Developments in Track Maintenance, the club will present a program designed to attract and interest those higher engineering and maintenance of way officers who plan to be in the city for the New York Railway Club dinner in the evening.

Maintenance of Way Club of Chicago

The club held a meeting at the Auditorium hotel at Chicago on Nov. 23, at which C. H. Longman, assistant to the vice-president and general manager of the Chicago & North Western, presented a paper on Accident Prevention. The meeting was attended by 52 members and guests.

On Dec. 14 the club will hold a joint meeting with the Chicago section of the American Welding Society, when Armstrong Chinn, chief engineer, Alton; C. B. Bronson, inspecting engineer, New York Central; and S. E. Tracy, welding supervisor, Chicago, Burlington & Quincy, will present a symposium on gas and electric welding as applied to track maintenance.

International Railway Maintenance Club

Twenty members and guests attended the last meeting of the International Railway Maintenance Club, held at the Hotel Statler, Buffalo, N. Y., on Nov. 12. The meeting was addressed by P. M. Allen, chief signal inspector of the New York Central, on the subject of signal maintenance and its relation to the work of the various departments of the railways. In the election of officers for the coming year, P. B. Garrison, assistant track supervisor on the New York Central, was elected president; S. B. Wass, division engineer, Canadian National, was elected vice-president; and E. W. Smith, Morrison Metalweld Process, Inc., was elected secretary-treasurer.

National Railway Appliances Association

The exhibit to be held in the Coliseum, Chicago, on March 15-18 during the conventions of the American Railway Engineering Association and the Signal Section, A.A.R., will materially exceed that of a year ago in number of exhibitors participating and in the amount of space required. At a meeting of the board of directors of the association at Chicago on November 5, applications for space were received from 77 companies whose requirements for space are already 50 per cent larger than the entire exhibit of a year ago. As a result, arrangements have been made to occupy the North Annex as well as the main hall of the coliseum.

The companies which have already contracted for space follow:

Adams & Westlake Co.
Air Reduction Sales Co.
American Car & Foundry Co.
American Fork & Hoe Co.
American Hoist & Derrick Co.
Armco Culvert Mfrs. Association
Austin-Western Road Machinery Co.
Barco Manufacturing Co.
The Barrett Co.
Bethlehem Steel Company
The Buda Company
Chicago Pneumatic Co.
Chipman Chemical Co.
Cleveland Frog & Crossing Co.
Cleveland Tractor Co.
Conley Frog & Switch Co.
Crerar, Adams & Co.
Cullen-Friestedt Company
A. P. DeSanno & Son
Paul Dickinson, Inc.
Duff-Norton Mfg. Co.
Eaton Manufacturing Co.
Elastic Rail Spike Corp.
Electric Tamper & Equipment Co.
Evans Products Co.
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.
Fansteel Metallurigcal Co.
General Electric Co.
Hayes Track Appliance Co.
Hubbard & Co.
Ingersoll-Rand Co.
Industrial Brownhoist Corp.
Johns-Manville Sales Corp.
O. F. Jordan Co.
Joyce-Cridland Co.
Kalamazoo Railway Supply Co.
The Kerite Insulated Wire & Cable Co., Inc.
Lehon Company
Locomotive Finished Material Co.
Lundie Engineering Corp.
Maintenance Equipment Co
Mall Tool Co.
Metal & Thermit Corporation
Morden Frog & Crossing Works
National Carbide Corporation
National Carbon Co.
National Lead Co.
National Lock Washer Co.
Nordberg Mfg. Co.
The Okonite Co.
The Oxweld Railroad Service Co.
The P & M Co.
Pettibone Mulliken Company
Pocket List of Railroad Officials
The Q & C Co.
The Rail Joint Co.
Railroad Accessories Corporation
The Rails Co.
Railway Engineering and Maintenance
Railway Maintenance Corporation
Railway Purchases & Stores
Railway Track-Work Co.
Pamapo Ajax Corp.
S. E. Rawls
Republic Steel Co.
Sellers Manufacturing Co.
Syntron Co.
Teleweld, Inc.
Templeton, Kenly & Co.
Thompson & Co.
United States Steel Corporation
U. S. Wind Engine & Pump Co.
Western Railroad Supply Co.
Yale & Towne Mfg. Co.

Associate members include:

American Chain Co.
Corning Glass Works
DeVilbiss Company
Frog, Switch & Mfg. Co.
General Railway Signal Co.
Gould Storage Battery Corp.
Inland Steel Co.
Jones & McLaughlin Steel Corp.
Massey Concrete Products Co.
National Aluminate Co.
Pittsburgh Plate Glass Co.
The Pyle National Company
Racor Pacific Frog & Switch Co.
Taylor-Wharton Iron & Steel Co.
Union Switch & Signal Co.
Warren Tool Company
Weir-Kilby Corp.
Youngstown Sheet & Tube Co.

American Railway Engineering Association

Marked progress in the completion of the committee reports to be presented at the convention in March is indicated by the fact that 11 reports are now in the hands of the secretary, of which 6 will appear in bulletin form within a week or two. Five committees held meetings in November and three others are scheduled to hold meetings in December for the purpose of putting the finishing touches on their reports. The committees that held meetings in November include those on Economics of Railway Location, at New York, on Nov. 6; Buildings, at Savannah, Ga., on Nov. 12 and 13; Economics of Railway Labor at Dallas, Texas on Nov. 17-18; Track, at Chicago, on Nov. 18; and Masonry, at Pittsburgh, Pa., on Nov. 18. The Committee on Records and Accounts will meet at Washington on Dec. 3; Water Service, in New York, on Dec. 4; and Rail, in New York, on Dec. 10.

Concurrent with a meeting of the Board of Direction at New York, on Nov. 5, the Nominating committee met at the same place for the purpose of selecting names to go on to the ballot that is to be mailed to the members shortly. The nominees are:

President, J. C. Irwin, valuation engineer, B. & A., Boston, Mass.

Second vice-president, E. M. Hastings, chief engineer, R. F. & P., Richmond, Va.

Secretary, E. H. Fritch (for re-election).

Treasurer, A. F. Blaess, chief engineer, I. C., Chicago.

Directors (three to be elected), Frederick Mears, assistant chief engineer, G. N., Seattle, Wash.; F. L. Nicholson, chief engineer, N. S., Norfolk, Va.; C. P. Richardson, engineer water service, C. R. I. & P., Chicago; J. G. Brennan, engineer of grade crossings, Association of American Railroads, Washington, D. C.; W. M. Vandersluis, general superintendent telegraph & signals, I. C., Chicago; E. P. Turner, principal assistant engineer, N. & W., Roanoke, Va.; C. S. Kirkpatrick, chief engineer, M. P., Houston, Tex.; J. B. Hunley, engineer bridges and structures, C.C.C. & St. L., Cincinnati, Ohio, and R. C. White, assistant general manager, M. P., St. Louis, Mo.

At the direction of the Association of American Railroads, the A.R.E.A. has recently issued a pamphlet of 73 pages comprising a reprint of material on track scales taken from the association's manual. This includes rules and specifications for the location, maintenance and testing of scales, as well as specifications for the manufacture and repair of scales. Individual copies of this pamphlet are being sold at 25 cents.

NOW

SAFE Rail Travel at HIGH SPEED

—and greater recognition of the valuable features of WOODINGS RAIL ANCHORS

Maximum Holding Power

High Re-Application Value

Low Application Cost

Economical Price

WOODINGS RAIL ANCHORS

Millions In Service

WOODINGS FORGE & TOOL CO.

VERONA, PA.

Personal Mention

General

J. J. Gallagher, district engineer on the Missouri-Kansas-Texas of Texas, with headquarters at Denison, Tex., has been promoted to superintendent of the North Texas district, with headquarters at the same point.

J. E. Crawford, for the last 12 years general manager of the Norfolk & Western, and chief engineer of the road from 1914 until 1923, has been elected vice-president in charge of operation, with headquarters at Roanoke, Va., succeeding **W. J. Jenks,** who was elected president of the road upon the death of **A. C. Needles** on October 25. **R. H. Smith,** general engineering and maintenance of way dedivision, with headquarters at Bluefield, W.Va., following an early career in the engineering and miantenance of way departments, has been promoted to general manager, succeeding Mr. Crawford. **W. O. Tracy,** superintendent of the Pocahontas division, with headquarters at Bluefield, who also rose through the engineering department of the road, has been promoted to general superintendent of the Western General division, succeeding Mr. Smith.

Engineering

S. A. Temple, track supervisor on the Baltimore & Ohio, with headquarters at Lima, Ohio, has been appointed industrial engineer in the commercial development department at Baltimore, Md.

N. C. Pearson, roadmaster on the Union Pacific, with headquarters at LaGrande, Ore., has been promoted to division engineer, with headquarters at Cheyenne, Wyo., to succeed **W. H. Lowther,** who resigned.

J. J. Desmond, division engineer of the Chicago Terminal division of the Illinois Central, who has been on a leave of absence because of ill health, returned to his duties on November 1. **F. W. Armistead,** division engineer at Clinton, Ill., who has also been on a leave of absence because of ill health, returned to his position on the same date.

W. D. Wiggins, acting chief engineer of the Pennsylvania System, has been appointed chief engineer of the system, to succeed **T. J. Skillman,** who has been appointed chief engineer-consultant. Both these officers will have their headquarters as before at Philadelphia. **W. B. Wood,** acting chief engineer of the Central region, with headquarters at Pittsburgh, Pa., has been appointed chief engineer of that region, succeeding Mr. Wigigns.

Mr. Wiggins was born in Richmond, Ind., on April 28, 1873. He entered railroad service in 1889, as a clerk in the office of the road foreman of engines and general foreman of the Richmond shops of the Pittsburgh, Cincinnati & St. Louis (now part of the Pennsylvania), where he was employed for about three months. In 1892 he served for three months as an assistant on the engineer corps on the Richmond division and on September 1, 1895, after his graduation from Rose Polytechnic Institute, he re-entered the engineer corps at Logansport, Ind. After holding various positions in the maintenance of way and construction departments, he was appointed engineer of maintenance of way of the Cincinnati & Muskingum Valley (part of the Penna.) on June 10, 1901. Mr. Wiggins subsequently held the same position, and also that of division engineer, on several other divisions of the Pennsylvania lines west of Pittsburgh, Pa. On November 1, 1912, he was appointed superintendent of the Peoria division, and, on July 1 of the following year he was promoted to valuation engineer of the Pennsylvania lines west of Pittsburgh, serving in that capacity during the administration of the director general of railroads. On March 1, 1920, upon the termination of federal control, he was appointed chief engineer of maintenance of way, Central region, with headquarters at Pittsburgh and on April 1, 1926, he was promoted to assistant chief engineer with the same headquarters. On February 1, 1927, he was appointed to the newly-created position of chief engineer of the Central region at Pittsburgh. On

W. D. Wiggins

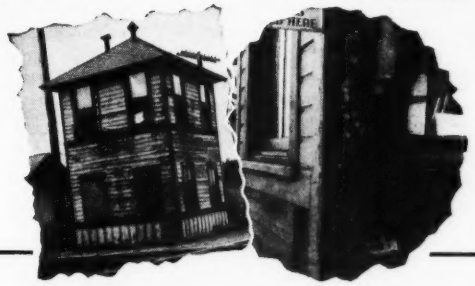
October 1, 1935, Mr. Wiggins was appointed acting chief engineer to take over the duties of Mr. Skillman, who was granted a leave of absence on account of ill health.

Mr. Wood was born on September 11, 1876, at Harrisburg, Pa., and was educated at Sheffield Scientific School, Yale University, from which he was graduated in 1897. He entered the service of the Pittsburgh, Cincinnati, Chicago & St. Louis (now part of the Penna.) on October 6, 1897, as a rodman in the chief engineer's office at Pittsburgh. In 1898 he was transferred to the chief engineer's office of the Pennsylvania and in 1899, he was appointed assistant engineer of the Cleveland and Pittsburgh division. In January, 1901, he was appointed engineer maintenance of way on the Cincinnati & Muskingum Valley (part of the Penna.) and in June, 1901, he was transferred to the Cleveland and Pittsburgh division. Mr. Wood was promoted to superintendent of the Richmond division in 1903, and later held the same position on various other divisions. On April 1, 1914, he was appointed general manager of the Grand Rapids & Indiana (part of the Penna.), retaining that position under the United

W. B. Wood

States Railroad Administration. On March 1, 1920, when the government relinquished operation of railroads, Mr. Wood was apopinted general superintendent of the Illinois division of the Pennsylvania, with headquarters at Chicago. For a short time in 1923 he was acting general manager of the Northwestern region, and on October 24, 1923, he was sent to New York, as general superintendent of the New Jersey division. On July 16, 1926, he was appointed assistant to the general manager of the Western region and on December 1, 1929, he became engineer in charge of the Baltimore improvements at Baltimore, Md. On October 1, 1935, he was appointed acting chief engineer of the Central region at Pittsburgh, which position he held until his recent promotion to chief engineer of that region.

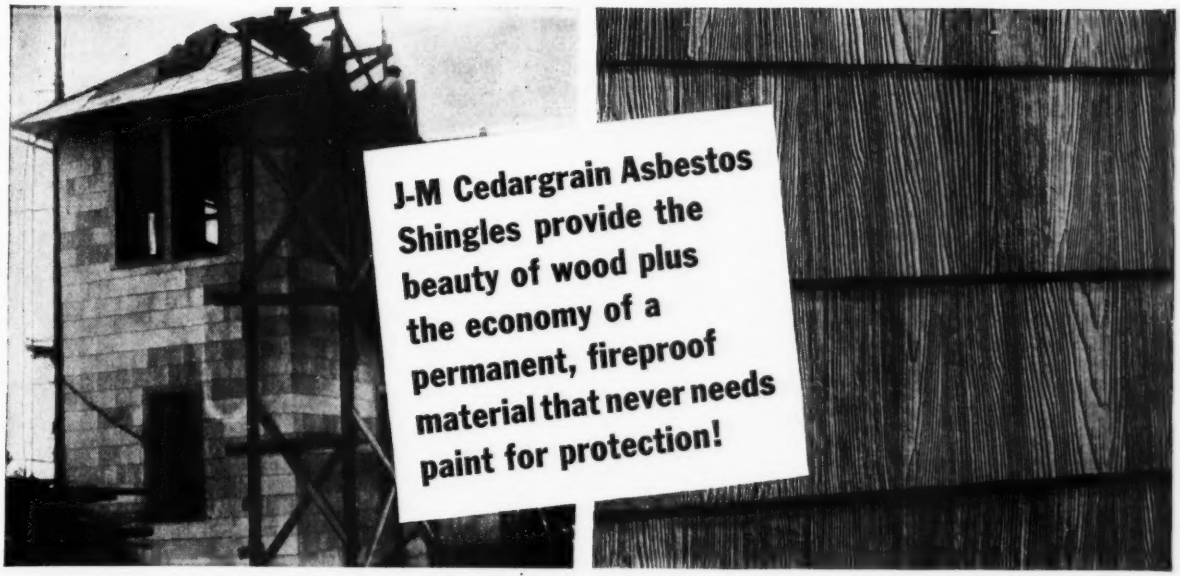
Mr. Skillman was born in Trenton, N. J., on November 6, 1876. He was educated at the State Model School, Trenton, and at Princeton University, graduating in 1898 with a civil engineering degree. Mr. Skillman entered the service of the Pennsylvania as a blue-print boy on March 1, 1899, and for the next six years he served in various capacities in the engineering department and as assistant track supervisor. On August 1, 1905, he was promoted to supervisor at Uniontown, Pa., later being transferred to Dravosburg, Pa., and thence to New York as supervisor in charge of track construction work on the Pennsylvania Tunnel and Terminal railroad. Mr. Skillman was appointed division engineer of the New York, Philadelphia & Norfolk (Penna.) at Cape Charles, Va., on June 16, 1913, and on December 1, 1914, he became division engineer of the West Jersey & Seashore and the Camden Terminal division at Camden, N.J.; and on April 16, 1917, he was transferred to the Monongahela division at Pittsburgh. On July 1, 1917, he was assigned to the office of the general superintendent of the New Jersey division, with



A POOR IMPRESSION ON PASSENGERS . . . AND POOR ECONOMY FOR ANY ROAD . . .

These sidewalls could be painted, but there is another way . . . more attractive and far more economical

How Much Better . . . These Imperishable, FIREPROOF SIDEWALLS!


J-M Cedargrain Asbestos Shingles provide the beauty of wood plus the economy of a permanent, fireproof material that never needs paint for protection!

PLENTY of painting to do on railroad buildings all over the country . . . there's no denying that.

But, since the last time these buildings were painted, Johns-Manville has developed and perfected a sidewall material that now offers you a decidedly more economical and permanent answer to this ever-present maintenance problem.

And that answer is J-M Cedargrain Asbestos Shingles. Reproducing the texture of fine wood shingles —yet permanent and incombustible because of their asbestos composition, these shingles provide your buildings with lasting protection against fire, weather and wear.

Cedargrains' well-kept appearance on signal towers, stations and other buildings speaks well for the road. They cannot split or rot, never need paint to protect their weatherproof surface! And the applied cost of these shingles is surprisingly low!

Why not get full details on J-M Cedargrain Asbestos Shingles—the latest product to carry forward Johns-Manville's 78-year record of service to transportation? For complete information on Cedargrains, address Johns-Manville, 22 East 40th Street, New York City.

Johns-Manville SERVICE TO TRANSPORTATION

J-M MATERIALS CARRY ON A 78-YEAR SERVICE RECORD

special duties in connection with the study of terminal development at New York. On October 1, 1917, he was appointed division engineer of the New York division at Jersey City and on November 10, 1919, he was made principal assistant engineer of the Eastern Pennsylvania division, at Altoona. On March 1, 1920, he was appointed chief engineer maintenance of way, Northwestern region, with headquarters at Chicago. Upon the consolidation

T. J. Skillman

of the Northwestern and Southwestern regions on June 1, 1925, Mr. Skillman became chief engineer maintenance of way, Western region, and on April 1, 1926, he was promoted to the newly-created position of assistant chief engineer, at Chicago. He was transferred to the Long Island (part of the Penna.) on July 6, 1926, as chief engineer and was advanced to chief engineer of the system on February 1, 1927. On October 1, 1935, Mr. Skillman was granted a leave of absence because of ill health.

W. C. Pruett, assistant general foreman in the maintenance of way department of the Missouri-Kansas-Texas, with headquarters at Muskogee, Okla., and formerly district engineer at Muskogee, effective October 15 was reappointed district engineer on the Texas lines of the Katy, with headquarters at Denison, Tex., to succeed **J. J. Gallagher,** whose promotion to superintendent is noted elsewhere in these columns.

C. E. Crippen, assistant engineer in the water service department of the Chicago, Milwaukee, St. Paul & Pacific, at Chicago, has been promoted to division engineer of the Dubuque-Illinois division, with headquarters at Savanna, Ill., to replace **E. H. Johnson,** who has been transferred to the Trans-Missouri division with headquarters at Miles City, Mont., relieving **H. B. Christianson,** who has been transferred to the LaCrosse and River division, with headquarters at LaCrosse, Wis., where he replaces **W. F. McDonald,** who has been transferred to the Milwaukee division with headquarters at Milwaukee, Wis., relieving **Walter Lakoski,** who has been appointed division engineer of the Terre Haute division, with headquarters at Terre Haute, Ind. **T. H. Strate,** who has been division engineer of the Chicago Terminal and Terre Haute divisions, retains jurisdiction over the Terminal division. All of these changes are effective December 1.

C. S. Weatherill, bridge and building supervisor of the Eastern division of the Minneapolis & St. Louis, has been promoted to division engineer of the Eastern division, with headquarters as before at Oskaloosa, Iowa. In his new capacity, Mr. Weatherill will continue to have charge of bridge and building work on the Eastern division as well as track maintenance work. He was born on August 26, 1891, at Newburg, Minn., and received his higher education at the University of Minnesota, graduating with a degree in civil engineering in 1915. Mr. Weatherill entered the service of the M. & St. L. in April, 1916, as an instrumentman, serving in this capacity until January, 1917, when he was appointed assistant engineer. Ten years later he was further advanced to supervisor of track at Estherville, Iowa. From November 1, 1929, to June, 1933, he served as supervisor of bridges and buildings at Ft. Dodge, Iowa, then being appointed supervisor of track at Oskaloosa. From November, 1933, until his recent appointment, which was effective on October 1, Mr. Weatherill held the position of supervisor of bridges and buildings of the Eastern division with headquarters at Oskaloosa.

Track

N. E. Noel, general extra gang foreman on the Dubuque and Illinois division of the Chicago, Milwaukee, St. Paul & Pacific, has been promoted to roadmaster on the Madison division, with headquarters at Janesville, Wis., succeeding **A. C. Tubaugh,** who has been granted a leave of absence.

E. M. Skelton, acting assistant supervisor of track on the Syracuse division of the New York Central, with headquarters at Syracuse, N. Y., has been appointed assistant supervisor of track on the same division, with headquarters at Lyons, N.Y., to succeed **E. F. Anderson,** whose death on October 13 was announced in the November issue.

R. R. Moorman, general track foreman on the Baltimore & Ohio, with headquarters at Cincinnati, Ohio, has been promoted to track supervisor, with headquarters at Indianapolis, Ind., to succeed **W. M. Wells,** who has been transferred to Lima, Ohio. Mr. Wells replaces **S. A. Temple,** whose appointment as industrial engineer, is noted elsewhere in these columns.

George Babcock, assistant track supervisor on the Pere Marquette, has been promoted to track supervisor, with headquarters at Grand Rapids, Mich., to succeed **U. Harger,** deceased. Mr. Babcock has been identified with the Pere Marquette for 13 years. He was born on March 30, 1907, at West Olive, Mich., and entered the service of the P.M. on June 14, 1923, as a track laborer. In 1932 he was advanced to relief foreman, and on August 15, 1935, he was further promoted to section foreman. A year later he was made assistant track supervisor, which position he held until his recent promotion to track supervisor, effective on October 16.

L. I. Hammond, roadmaster on the Union Pacific, with headquarters at Laramie, Wyo., has been promoted to general roadmaster, with headquarters at Cheyenne, Wyo., to succeed **L. C. Ferguson,** who has been appointed roadmaster at North Platte, Neb. **J. E. Swanson,** roadmaster at North Platte, has been transferred to Laramie, to replace Mr. Hammond. **Ralph Cook** has been appointed roadmaster, with headquarters at Salina, Kan., to succeed **W. H. Cosgrove,** who has been transferred, with the same headquarters, to succeed **V. C. Breit.** Mr. Breit has been transferred to Marysville, Kan., where he succeeds **W. F. Hart,** who goes to Rawlins, Wyo., in place of **M. A. Hardesty,** who has been assigned to other duties.

F. A. Burroughs, Jr., assistant supervisor on the St. Louis-Louisville division of the Southern, with headquarters at Princeton, Ind., has been promoted to track supervisor on the same division, with headquarters at Huntingburg, Ind., succeeding **F. H. Sims,** who has been assigned to other duties at his own request. **A. H. Exon** has been appointed assistant supervisor at Princeton, to replace Mr. Burroughs. **T. W. Kinsley** has been appointed assistant supervisor on the Birmingham division, with headquarters at Birmingham, Ala., to succeed **H. C. Floyd,** who has been transferred to the office of the chief engineer, maintenance of way and structures, at Cincinnati, Ohio. **J. G. Woodall,** bridge and building supervisor on the north end of the Cincinnati, New Orleans & Texas Pacific (part of the Southern), with headquarters at Lexington, Ky., has been appointed assistant roadmaster on the St. Louis-Louisville division, with headquarters at Louisville, Ky.

Mr. Burroughs was born on June 19, 1903, at Raleigh, N.C., and was educated at Wake Forest college, graduating in 1929. On December 29 of the same year he entered railway service with the Southern as a track laborer, holding this position until July 1, 1930, when he was appointed a student apprentice. Four years later Mr. Burroughs was promoted to assistant bridge and building supervisor, the position he was holding at the time of his recent appointment as track supervisor.

C. McGhee, supervisor of track on the Pennsylvania, with headquarters at Struthers, Pa., has been transferred to Lewistown, Pa., succeeding **C. W. Heinze,** who has been transferred to Dennison, Ohio. **W. T. Rice** has been appointed assistant supervisor at Lock Haven, Pa., succeeding **N. L. Flackenstine,** who has been transferred to Rochester, Pa., where he succeeds **H. L. Byrne,** who has been transferred to Williamsport, Pa. **F. W. Artois,** supervisor with headquarters at Williamsport, has been transferred to Canton, Ohio. **W. R. Taylor** has been appointed assistant supervisor at York, Pa., succeeding **M. Young** who has been transferred to Trafford, Pa. **E. S. Barrett** has

DOUBLE

the Heating and Welding capacity of your AIRCO-DB Welding Torch with the AIRCO-DB

TWO-FLAME TIP

Two torches in one—that's what it amounts to when you screw this TWO-FLAME TIP to the handle of the regular AIRCO-DB Welding Torch. By providing double the amount of heat, the temperatures required in building up rail ends and in heat treating, are reached much faster and with less dissipation of heat through the rail. Obviously this means a saving of gases and material as well as time. Use the AIRCO-DB TWO-FLAME TIP and cut the cost of your rail end welding and heat treating. WRITE for details.

AIR REDUCTION SALES COMPANY

General Offices: 60 E. 42nd St., New York, N.Y.

DISTRICT OFFICES in PRINCIPAL CITIES

been appointed acting assistant supervisor, with headquarters at Harrington, Del., to take the place of **H. N. Lippich,** who has been transferred as acting assistant supervisor to Washington, D. C. Mr. Lippich succeeds **K. L. Silvey,** who has been appointed acting supervisor at Harrington. **W. F. Neale,** acting assistant supervisor on the Maryland division, has been appointed assistant supervisor in the office of the engineer maintenance of way at Harrisburg, Pa. **W. T. Hammond,** has been appointed acting supervisor of track at Orrville, Ohio, to take the place of **R. W. Grigg,** supervisor, who has been assigned to special duties in the office of the chief engineer, system, with headquarters at Philadelphia, Pa.

J. H. Edmonson, whose appointment as track supervisor on the Illinois Central, with headquarters at Monroe, La., was reported in the October issue, was born on November 10, 1891, at Enterprise, Miss. Mr. Edmonson first entered railway service on August 15, 1908, as a track laborer on the Tremont & Gulf, being advanced to section foreman on this road on April 1, 1910. On February 1, 1912, he entered the service of the Vicksburg, Shreveport & Pacific (now part of the Illinois Central), as a section foreman, being advanced to supervisor of track on November 12, 1923. From October 1, 1926, to November 1, 1931, Mr. Edmonson served as an extra gang foreman, then being appointed a section foreman. He was holding the latter position at the time of his recent appointment as track supervisor, with headquarters at Monroe.

Bridge and Building

N. R. Tucker, an instrumentman on the Southern Pacific Lines (in Texas and Louisiana), has been promoted to assistant supervisor of bridges and buildings, with headquarters at Lafayette, La.

A. A. Riley, assistant supervisor of structures of the Southern Pacific Lines in Texas and Louisiana, has been promoted to supervisor of structures, with headquarters as before at Houston, Tex., to succeed **H. H. Ueckert,** whose death on September 29 was reported in the November issue.

L. C. Crissinger has been appointed bridge and building supervisor of the north end of the Cincinnati, New Orleans & Texas Pacific (part of the Southern), with headquarters at Lexington, Ky., succeeding **J. G. Woodall,** whose appointment as assistant roadmaster is noted elsewhere in these columns.

Louis F. Yeager, bridge and building foreman on the Mohawk division of the New York Central, with headquarters at Utica, N. Y., has been promoted to bridge and building inspector on the Syracuse division, with headquarters at Syracuse, N.Y., succeeding **E. E. Fobes,** who has been promoted to assistant supervisor of bridges and buildings on the Mohawk division, with headquarters at Albany, N.Y. Mr. Fobes succeeds **K. L. Miner,** who has been promoted to supervisor of bridges and buildings on the Eastern division, with headquarters at Beacon, N.Y., to succeed **E. E. Wilson,** who has been appointed bridge and building inspector, with headquarters, as before, at Beacon.

Herbert F. Turnbell, assistant supervisor of bridges and buildings on the New York, Chicago & St. Louis, whose promotion to supervisor of bridges and buildings was announced in the November issue, was born on January 12, 1882, in Wood county, Ill. After a common school education Mr. Turnbell entered the service of the Lake Erie & Western (now part of the Nickel Plate) as a bridge carpenter on the Northern Ohio division. In 1913 he was advanced to bridge foreman and in 1923, he was further promoted to assistant supervisor of bridges and buildings of the Lake Erie & Western district of the Nickel Plate. He was holding the latter position at the time of his recent promotion to supervisor of bridges and buildings.

Obituary

F. E. Box, roadmaster on the Gulf, Colorado & Santa Fe, with headquarters at Temple, Tex., died on November 21.

Charles Patterson McCausland, engineer in charge of surveys and railway construction for the Western Maryland, with headquarters at Baltimore, Md., died on November 5 at his home in that city. He was 55 years old.

Supply Trade News

General

Sika, Inc., has moved its office from the Grand Central Terminal building to 330 West Forty-second street, New York.

Eastern Railway Suplies, Inc., 110 East Forty-second street, New York, has been formed to carry on a general railway supply business and will immediately represent the **Nordberg Manufacturing Company,** Milwaukee, Wis., and other manufacturers of railway materials and equipment. The company will be represented by **Waldo E. Bugbee,** who was formerly associated with the National Lock Washer Company, and who has had several years experience in the railway supply field. The incorporators of the new concern include Ralph W. Payne, Washington, D.C., and Stanley H. Smith, Cleveland, Ohio, both of whom will continue to carry on their present businesses in those cities.

Personal

R. H. Sonneborn, special representative of the pipe division of the **Republic Steel Corporation,** Cleveland, Ohio, has been promoted to assistant manager of sales of the pipe division.

George B. Cushing, who in 1931 organized a technical promotion group now known as the engineering service department of the **A. M. Byers Company,** Pittsburgh, Pa., has been appointed manager of sales promotion. Mr. Cushing joined the A. M. Byers Company in 1928 to organize and head its present advertising department. **B. D. Landes,** who has been in the technical group since its inception, has been appointed manager of the engineering service department. **T. C. Winans,** in the advertising department since 1930, has been appointed advertising manager. Both the manager of the engineering service department and the advertising manager become a part of the newly formed sales promotion group headed by Mr. Cushing. **R. H. Gardner,** formerly of the Washington, D. C., office of the company, has been appointed manager of pipe sales and will take over all sales management duties in connection with wrought iron and steel tubular products.

Albert E. Hill, service engineer of **Standard Equipments, Inc.,** with headquarters in New York, has been appointed western manager in charge of sales and engineering, with headquarters at Chicago.

Edward A. Morse, vice-president of the Potosi Tie & Lumber Company, St. Louis, Mo., and first vice-president of the Railway Tie Association, was killed in an accident on October 31, when the automobile he was driving struck a culvert and turned over two miles north of Piedmont, Mo. He was born in St. Louis, Mo., in 1883, and attended Smith academy and Culver Military academy. He began his business career as a clerk for the St. Louis-San Francisco and, in 1905, entered the employ of the Western Tie & Timber Company. In 1908 he was promoted to secretary of the company, which position he held until 1913, when he disposed of his interests to engage in business for himself. In that year he organized the Morse Land & Timber Company, Jonesboro, Ark., and operated on a tract of land on the line of the old Bonneville & Southwestern for 10 years. In 1923 he was appointed vice-president of the Potosi Tie & Lumber Company, which position he was holding at the time of his death. Mr. Morse had been interested in the Railway Tie Association since it was organized. He served as secretary in 1927 and 1928 and for a number of years as a member of its executive committee. At the convention in Cincinnti last May he was elected first vice-president.

Edward A. Morse

When Surfacing is Completed With These I-R Tamping Machines

"You don't have to fool with it anymore"

THAT'S what a track foreman says . . . . whose section is part of one of the heaviest traffic lines in the United States . . . where the outstanding money-saving advantage of I-R Pneumatic Tie Tampers are being continuously demonstrated under service conditions of undeniable severity.

Once a track has been resurfaced with I-R Tampers—*it stays that way for an indefinite period.* With I-R Pneumatic Tampers, the ballast is firmly and uniformly compacted under each tie—around and under frogs, switches, cross-overs, water pans; through interlocking switches, ladders, guard rails and other places virtually impossible to reach with picks or bars.

And—when I-R Pneumatic Tampers are used, not only does the finished job last much longer and cost less but you have every assurance of smooth, safe, running conditions, regardless of how much heavy, high-speed traffic your track is called upon to carry.

470-11

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cleveland, Dallas, Detroit, Denver, Duluth, El Paso, Hartford, Houston, Knoxville

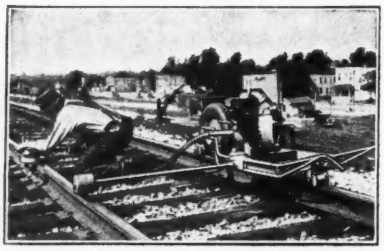
Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

Los Angeles, Newark, New York, Philadelphia, Picher, Pittsburgh, Pottsville, San Francisco, Salt Lake City, Scranton, Seattle, St. Louis, Tulsa, Washington

Mall
TRADE MARK

RAIL GRINDERS



New MALL 5 H.P. Rail Grinder with Outrigger Grinding Surface Welds

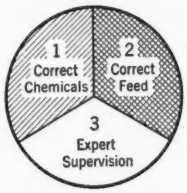
For Rail Surface, Frog, Crossing, and Switch Point Grinding, Drilling, and Lag Screw Driving.
These efficient machines do fast, accurate work on all rail maintenance jobs.

CONCRETE VIBRATORS

MALL vibrators are of the internal type and are immersed directly into the low slump concrete. They are ideal for placing or compacting concrete in bridges, pavements, buildings, walls, and floors. These units are many machines in one. The power unit that runs the vibrator will also operate a sump pump, concrete rubbing, drilling, sawing, or sanding attachment.

Write for descriptive literature

MALL TOOL COMPANY
7746 SOUTH CHICAGO AVENUE
Offices in all principal cities Chicago, Illinois



IT'S A TRIPLE JOB

Ending locomotive boiler scale trouble with internal boiler feedwater treatment

You can't end boiler scale troubles satisfactorily with just a water analysis and a chemical prescription. The chemicals must be properly fed to meet the changing characteristics of load and water.

Permutit furnishes the analyses—the prescriptions and the feeds—but even that isn't enough. The most vital factor of all is *experience*.

So Permutit also furnishes expert supervision by water conditioning specialists, to observe water treatment operations in your shops—to make sure that you get the benefits you pay for. When you call in Permutit, we go with you all the way!

For counsel on any water conditioning problem—of any kind and on any scale—write THE PERMUTIT COMPANY, Dept. F. 1, 330 West 42nd St., New York, N.Y.

Permutit
Water Conditioning

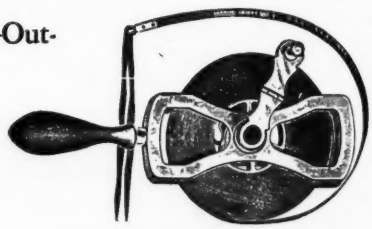
RUGGED SLUG *Devil* MAULS

WARREN TOOL CORP.
WARREN, OHIO

LUFKIN HI-WAY DRAG TAPES

Designed especially for Railroad and Highway Work—Outwears all other Chain Tapes!

Line is of special tough steel and with extraordinary resistance to wear and tear. Prominent black lines and figures cut into bright portions of the line. Easy to read. Sturdy metal reel.
Send for Catalog



THE LUFKIN RULE CO. SAGINAW, MICH., U. S. A., 106-110 Lafayette St., New York, N. Y.

BOOKS THAT HELP MAINTENANCE MEN

Track and Turnout Engineering

By C. M. KURTZ

Engineer, Southern Pacific Company

This new handbook for location, construction and maintenance of way engineers, transitmen and draftsmen, gives practical mathematical treatment of track layout and other problems. These are fully exemplified and worked out in detail, and illustrated with drawings of accepted designs for fixtures and track layouts. It contains original as well as a complete set of standard railway engineering handbook tables. All computing problems which may arise in track engineering are thoroughly treated.

457 pages, 116 illustrations, 33 tables, flexible binding, 5x7, $5.00

Practical Track Work

By W. F. RENCH

Formerly Supervisor, Pennsylvania Railroad

A new book giving expert information on the design, fabrication and installation of standard railroad trackwork. Thoroughly describes switch stands, switches, frogs, crossings and slip switches.

256 pages, 110 illustrations, tables, flexible binding, 5x7, $1.50

Roadway and Track

By W. F. RENCH

Packed full of practical information written on a background of 25 years experience. The meat of modern maintenance practice is in this book. It is the most complete work on the subject.

Second Edition, 226 pages, 44 illustrations, cloth, 6x9, $2.00

Simplified Curve and Switch Work

By W. F. RENCH

Formerly Supervisor on the Pennsylvania

This little book has practically revolutionized curve and switch calculation practice since its appearance 12 years ago. The proved accuracy of its methods has caused them to be adopted as standard practice on many roads.

Complex algebraic and geometric calculations are reduced to their simplest form and as nearly as possible to terms of simple arithmetic. Application of these calculations to the actual job is made plain by brief explanations. Drawings further clarify the subject and make the meaning of the text unmistakable. Tables of dimensions are a further help to the track foreman.

Short cut formulae are featured. String lining and tape line layouts are fully explained. While retaining practically all of the rules and principles which have been tested in previous editions, changes have been made in several detailed features to correspond to improved designs. A flexible binding makes the new edition more convenient to slip in the pocket and carry on the job.

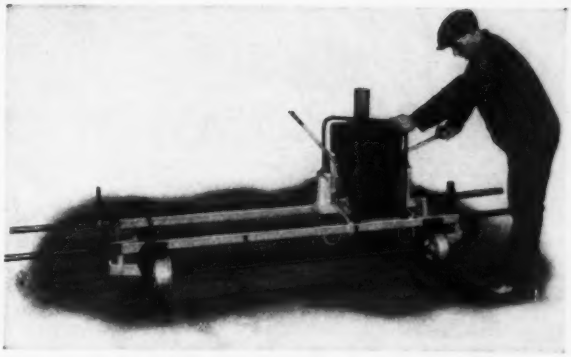
Fourth Edition, 212 pages, 24 illustrations, 5x7, cloth, $2.00

SIMMONS-BOARDMAN PUBLISHING CORP.,
30 Church St., New York.

Please send me for 10 days' free examination the books checked below. I will either remit list price or return the books within that time.

☐ Simplified Curve and Switch Work ☐ Practical Track Work
☐ Track and Turnout Engineering ☐ Roadway and Track

Name .....
Address .....
City ..... State .....
Position ..... Company ..... RE&M 12-36



Model P-11, Rail Joint Cross Grinder
A portable cross grinder for removing overflowed metal from rail ends and slotting closed and welded joints. This machine, owing to certain mechanical features, attains high production. accuracy, efficiency and economy.

Railroad Enemy Number One

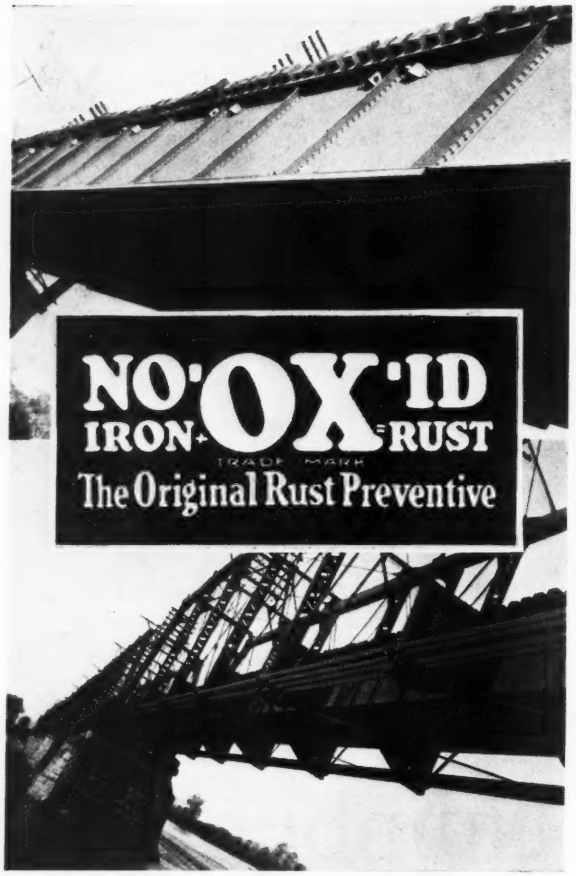
Poorly maintained track levies tribute all along the line. Battered rail ends, worn switches and crossings, corrugations ruin track foundations, increase rolling stock maintenance, rob passengers of time, comfort and protection.

Model P-22—Portable Flexible Shaft Grinder, gasoline engine driven free hand grinder operating either a cup or straight grinding wheel for grinding surface welded joints, crossings, frogs, switch points and stock rail. One of many models.

Railway Trackwork Co.
3132-48 East Thompson St., Philadelphia

WORLD'S HEADQUARTERS FOR TRACK GRINDERS

6472



The Saving Angle in Bridge Maintenance

Dearborn field and chemical engineers working with building and bridge men have developed the most economical method of bridge maintenance.

Employing the ability of NO-OX-ID A Special to penetrate and loosen scale and old coatings, the material is applied after removing only the loose particles. The chemical action of NO-OX-ID stops all further pitting and corrosion. Occasional touch up of spots where remaining scale has fallen off may be necessary. After the NO-OX-ID A Special has stopped all corrosion and prepared the metal surface for a further coating, we recommend application of NO-OX-ID Filler, Black or Red, over which paint in any color may be applied, if desired.

The saving in labor of cleaning and other costs makes possible greatly increased maintenance work without an increased budget.

Investigate the NO-OX-ID angle of saving.

DEARBORN CHEMICAL COMPANY

310 S. Michigan Ave., CHICAGO 205 East 42nd St., NEW YORK
Canadian Factory and Offices: 2454-2464 Dundas St., W., Toronto

ALPHABETICAL INDEX TO ADVERTISERS

A

Air Reduction Sales Company....809
American Fork & Hoe Company, The....769
Armco Culvert Mfrs. Assn....764

B

Barco Manufacturing Company....763

C

Carnegie-Illinois Steel Corporation....760-767
Columbia Steel Company....760-767

D

Dearborn Chemical Company....814

E

Eaton Manufacturing Co....758

F

Fairbanks-Morse & Co....765
Fairmont Railway Motors, Inc....761

I

Ingersoll-Rand....811
Ingot Iron Railway Products Co....764

J

Johns-Manville Corp....807

L

Lufkin Rule Co., The....812
Lundie Engineering Corporation, The....759

M

Mall Tool Company....812
Metal & Thermit Corporation....770

N

National Lock Washer Co....757
Nordberg Mfg. Co....815

P

Permutit Co., The....812

R

Rails Co., The....816
Railway Track-work Co....813
Ramapo Ajax Corporation....772

S

Simmons-Boardman Pub. Co....766-813

T

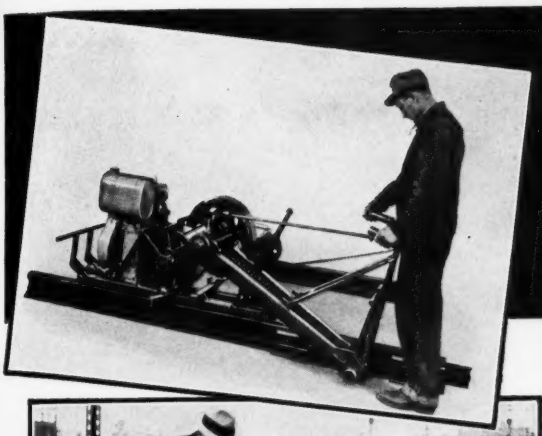
Truscon Steel Company....762

U

United States Steel Corporation Subsidiaries....760-767
United States Steel Products Company....760-767

W

Warren Tool Corp....812
Woodings Forge and Tool Co....805
Woodings-Verona Tool Works....805



Save time and money . . get better track by putting these Nordberg maintenance tools on the job

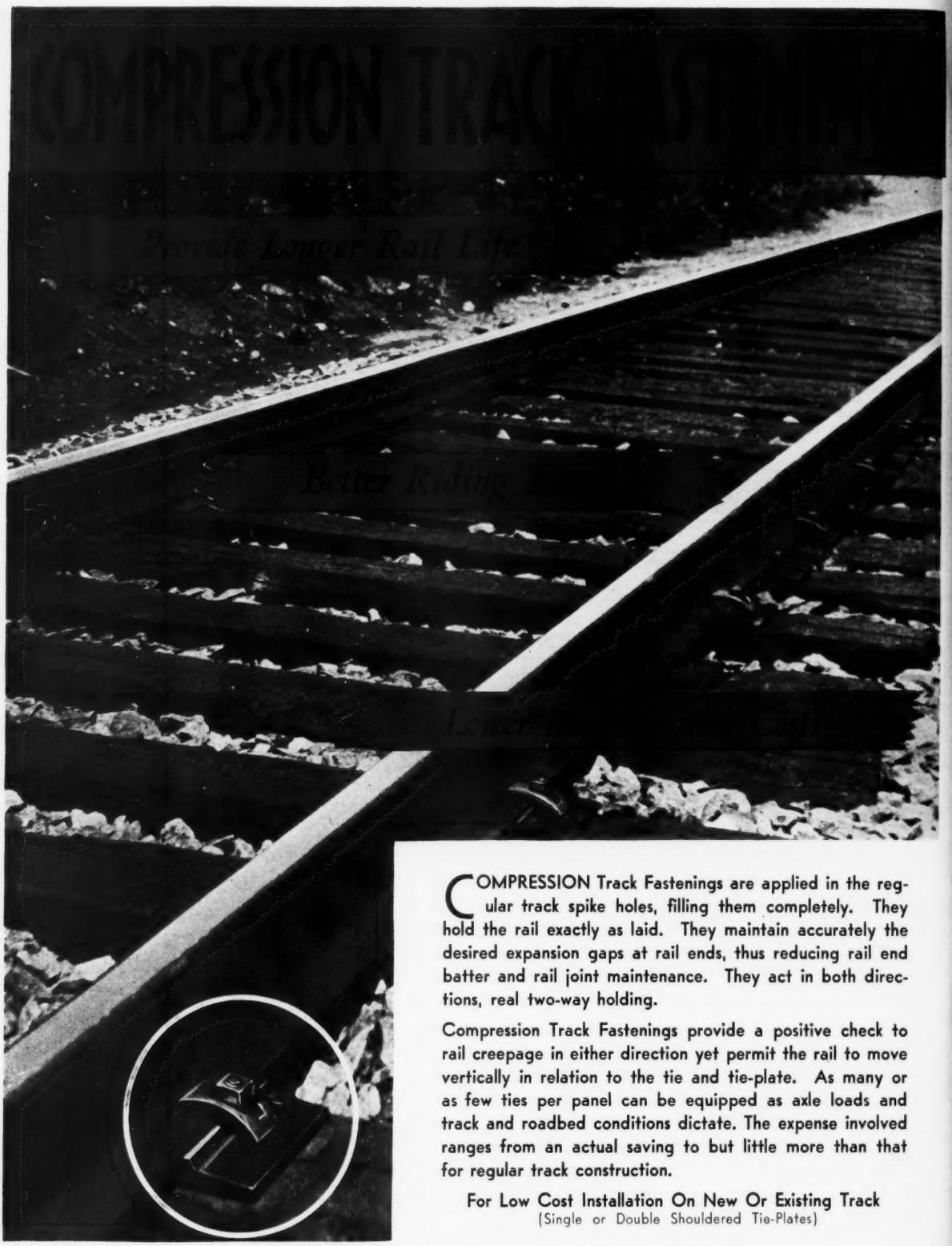
Get them in the budget for next year's operations

The advantage of power tools on maintenance work is evidenced by their rapidly growing use. Railroad management too is realizing more and more the necessity of machinery in place of hand operations. Power tools were essential for the rapid progress made on many of this year's major track programs and are recognized as essential for maintaining track in keeping with the demands of heavier and faster traffic.

Next year's plans are now up for consideration. Nordberg tools put in to the budget is assurance that future track maintenance work will be done better, faster, and with less expense.

Adzing Machine
Power Wrench
Power Jack
Grinders
Spike Puller
Rail Drill
Track Shifter

NORDBERG MFG. CO.
MILWAUKEE, WIS.



COMPRESSION Track Fastenings are applied in the regular track spike holes, filling them completely. They hold the rail exactly as laid. They maintain accurately the desired expansion gaps at rail ends, thus reducing rail end batter and rail joint maintenance. They act in both directions, real two-way holding.

Compression Track Fastenings provide a positive check to rail creepage in either direction yet permit the rail to move vertically in relation to the tie and tie-plate. As many or as few ties per panel can be equipped as axle loads and track and roadbed conditions dictate. The expense involved ranges from an actual saving to but little more than that for regular track construction.

For Low Cost Installation On New Or Existing Track
(Single or Double Shouldered Tie-Plates)

THE RAILS COMPANY

GENERAL OFFICE
178 GOFFE ST.
NEW HAVEN, CONN.

NEW YORK OFFICE
50 CHURCH ST.
NEW YORK CITY